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WHITE MOUNTAIN RESEARCH STATION
UNIVERSITY OF CALIFORNIA, BERKELEY

SEMI-ANNUAL STATUS REPORT

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Related to Space Flight

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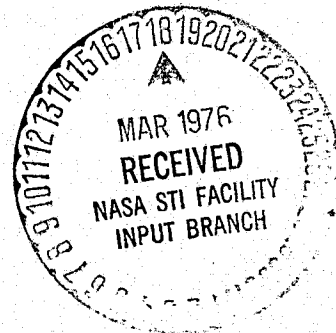
Report Number: Twenty-Seven (27)

Grantee: Regents of the University of California

Principal Investigator: Nello Pace

Co-Investigators: Benjamin W. Grunbaum
Arthur M. Kodama
Richard C. Mains
Donald F. Rahlmann

Technical Assistant: Edward J. Gorman



OBJECTIVE

To establish physiological base-line data, and to develop physiological procedures and instrumentation necessary for the measurement of hemodynamic and metabolic parameters during prolonged periods of weightlessness.

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I. BIOINSTRUMENTATION

A. *Monkey Pod Mark III-1 Completion.*

As noted in Status Report #26, the partially completed Mark III-1 monkey pod was delivered to NASA Ames Research Center on 28 January 1975. Suitable personnel were not immediately available and work was not initiated until 31 March 1975. On-site contact was maintained with the various branches involved during all phases of construction. Completion of fabrication of the Mark III-1 was attained on 26 June 1975 and, on that date, it was transported to the Environmental Physiology Laboratory on the UCB campus. Following a preliminary bench testing, the first monkey interface test was conducted from 1130 of 8 July 1975 to 1030 of 11 July 1975. A summary of this test is reported in the following paragraphs.

Pig-tailed monkey #337, Simple, was installed in the pod on 8 July but could not be connected to the Pod Instrument Console because another animal was undergoing a 15-day test. For the first day of the test, upper-pod airflow was provided by a bellows pump and a float-type flowmeter. A water trap was placed in the exhaust line to prevent condensation from blocking airflow through the flowmeter.

At 1600 on 8 July the feeder level spring return malfunctioned. The upper pod was removed, the feeder disassembled, and a broken spring was repaired. The subject then had no problems actuating the feeder for the remainder of the test.

At 1045 of 10 July the Mark III-1 pod was attached to the Instrument Console and the 4 upper-pod gas concentrations were monitored until the end of the test.

The assembly and disassembly procedure for this pod is basically the same as its predecessor and will not be discussed in this report. Several

design changes have been made in the Mark III-1 pod, however, and most of them are evaluated below based on this preliminary test.

Couch

(a) Increased width (1.125 inch): This change was made to simplify the couch spacer bar attachment and to provide more room in the seat area for monkey movement, and a wider hammock in the upper half of couch facilitating support of the monkey in the supine position. The increased width has satisfactorily produced these results but necessitated changes in the jacket hammock width and the leg divider.

(b) Nylon couch fittings: The upper and lower leg restraint bars and the foot bar were made of 0.75-inch diameter nylon rod. All of these items were formerly 0.5-inch diameter stainless steel rod. Nylon is lighter and is not cold to the touch, and appears to be compatible with urine and feces. Insulating the foot bar is no longer necessary. An increase in the width of the leg divider was necessitated by the increased couch width. The leg divider was formerly 0.5-inch lucite and was always coated with hard-to-remove mineral deposits. The new one is 1.75-inch diameter nylon rod, is simple to fabricate, keeps subject's legs restrained, and cleans easily. Adjustment in smaller increments has been provided in the leg restraint bars. This change allows the bars to be set as loosely as possible for a given monkey. Nylon appears to be a very satisfactory material for the above items.

(c) Silicone gel seat: A one-piece seat cushion was fabricated at EPL from cast silicone gel (Dow Corning, F-13-523), spray-coated with silicone dispersion (Dow #92-009), reinforced with nylon tricot fabric, and bonded to two stainless steel attachment plates. This seat potentially has two major advantages over the earlier silicone coated urethane foam seat. The silicone gel has mechanical properties very similar to fat tissue and should give

excellent support during long term restraint, and it should not collapse due to air leakage when under pressure.

The test results indicate that the gel seal worked very well. No abrasions were observed. The seal was clean after removal of the subject, and all feces had dropped through the feces hole. A pressure line was seen on each ischial callosity at the interface of the feces hole and callosity. This same effect was observed recently with another monkey and the Mark III couch, and thus appears not to be unique to the Mark III-1 couch. A design change in the feces hole might give more support to the callosities.

Divider Assembly

The most significant change was the creation of a continuous horizontal lip upon which the LBNP support plate "O" ring could seal. This eliminated the problems (lubrication of "O" ring, precise fit) inherent in attempting to make this seal on a vertical surface. This system appears to make an adequate seal on the divider rim, but a leak test has not been performed. A stainless steel ring insert was added to the surface of the divider to which the retainer ring is screwed. This addition was made necessary due to inadequate holding strength of threaded inserts bonded in place in this rim. A rubber gasket has been added to the bottom surface of the compression ring and this system appears to provide adequate clamping action on the jacket and divider seal permimeters.

The retainer ring was fashioned in two pieces, which simplified the assembly procedure and allowed an arm tray to be added on top of the front half. This tray protected the jacket skirt from being chewed by the subject. This tray touches the abdomen on fat monkeys and does not adequately cover the skirt for thinner subjects. Two sizes of arm tray, or an adjustable model, should be made to accommodate the range in monkey sizes.

A technique for securing both the jacket and divider seal perimeters to the compression ring prior to placement of the couch in the pod would greatly simplify the assembly procedure.

Pod

The pod main flange seal was changed by bonding a more compressible "O" ring (silicone tubing) to the upper half of the pod. This allowed a better seal and prevented the monkey from grabbing the loose "O" ring. A stainless steel Marmon clamp effects the clamping action for this seal and is easier to apply. This seal has not been leak-tested. A clamp that has two 180-degree sections with two clamp mechanisms would perhaps give a more even pressure, but would be a little more awkward to apply. The clamp appeared to be adequate for the present time.

The lower-pod contour adjacent to the couch feces hold was changed to provide more room for feces to fall free from the couch. This change appears to have been very effective.

A new pod stand attached with two screws to aluminum angles mounted on each side of the pod functioned well. This stand is more stable and it is easier for one person to remove and attach the pod to the stand as compared to the Mark III version.

Threaded inserts have been added to all pod port "bosses" so that screws do not thread directly into plastic. Unfortunately, as with much of the hand-work done on the pod at ARC, the placement of the inserts is not always accurate, so that it is sometimes difficult to thread screws through fittings into the inserts. This is only a minor annoyance, however. The inserts were added at the suggestion of ARC staff to meet aircraft flight stress qualifications.

Waterer and Control Box

A new waterer and feeder/waterer control box were fabricated based on the earlier EPL design for these items. Both items appear to function well and no problems were encountered during the test.

B. NASA/ARC Cardiovascular T/M Implant.

The Biomedical Research Division of NASA/ARC has designed and developed radio telemetry implants which are capable of transmitting physiological data from experimental animals and man. A recent implant with the potential of obtaining 2 vascular pressures, electrocardiograph and body temperature has been fabricated. The size of this device is small enough that it could reasonably be tolerated by a mature adult male pig-tailed monkey in 10-15 kg weight range for periods in excess of 6 months. Power to the unit is supplied by an externally placed energizing coil and thus eliminates the requirement of internal surgically placed batteries.

Providing an experimental subject to be implanted was accomplished by transporting an adult male #396, Lovel from EPL-UCB to NASA/ARC on 28 January 1975, as mentioned in Status Report No. 26. Arrangements were made to provide cage space and appropriate animal care. Plans were developed for surgery and subsequent performance evaluation by the EPL-UCB IPA representative and members of the NASA/ARC Biomedical Research Division Staff.

On 26 February 1975, a left thoracotomy was performed for the placement of the T/M unit with pressure transducers located in the left ventricle and aorta, ECG leads secured on the surface of the heart at the left ventricular apex and the left auricular appendage. The signal conditioner mainframe was placed intrathoracically below the 8th rib and the internal energizing and transmission coils in a pectoral muscle pocket. Recovery from surgery was satisfactory.

At least once or twice weekly #396, Lovel was tranquilized with Vetalar^(R), weighed, restrained in a nylon raschel net jacket, and placed in a chair. The restraint apparatus, supplied by EPL-UCB, enabled the experimenter to place the exterior energizing coil from the actuator in the appropriate position adjacent to the monkey body to maximize the quality of electronic signals. During initial stages of post-surgical recovery blood samples were obtained from the saphenous vein to ascertain the clinical state of the subject. On day 15 and day 118 after surgery #396, Lovel was anesthetized with an intravenous sodium pentobarbital injection and a catheter with a calibrated pressure transducer introduced percutaneously in order to check the reliability of the T/M signal. On both occasions the telemetered pulse wave did not compare precisely with that indicated by the catheter transducer. However, levels of systolic and diastolic pressure appeared to be very reasonably correlated.

Twice during this report period the T/M implanted monkey was placed within the Mark III monkey pod. The associated instrumentation involved with the transmission and reception of the physiologically related electronic signals was compatible.

A preliminary summary of T/M cardiovascular data obtained during the report period is shown in Table 1.

C. CV-990 Flight Proposal.

As an extension of ground-based experimentation with the EPL/UCB monkey pod, an aircraft flight mission has been under consideration. Contacts with the Airborne Science Office of NASA/ARC have been made by Dr. B. D. Newsom, Scientific Monitor at ARC for this grant. With the assistance of the IPA representative from EPL, additional information was obtained in regard to

the preparation of a proposal for this purpose. Considering the concept, size and procedural protocol of a multiple pod monkey trial, the CV-990 appeared to be the aircraft of choice rather than a Lear Jet or the C-141. It is anticipated that one or more of the trial subjects would be implanted with biotelemetry units. Initial flow diagrams, schedules and interfacing plans of the pod within the aircraft were compiled. A document entitled "Proposal for a CV-990 Systems Interface Test and Procedure Analyses of the Monkey Pod Restraint, Support Equipment and Analyses Electronics" authored by B. Newsom and D. F. Rahlmann was completed in July 1975 and submitted for approval through appropriate channels.

D. Two-Pod Integration Test.

Concepts and preliminary design considerations for a multiple pod physiological experiment system were described in Status Reports No. 25 and No. 26. The feasibility of this system was also discussed in the CV-990 flight proposal document (refer to Section IIC of this report). Following the completion of the Mark III-1 pod and subsequent monkey interface testing (refer to Section IIA of this report), a 2-pod commutation test was conducted from 29 July to 1 August 1975 at EPL-UCB. #341, Philostrate was placed in pod Mark III-1, while #174, Exeter was contained in pod Mark III. The 2-pod concept was demonstrated to be workable in this test. Additional hardware and instrumentation is required to complete this system in order to gather complete and meaningful data from both subjects. The results related to bioinstrumentation performance during this test are discussed in the following paragraphs.

Couch, restraint and divider.

(a) #341, Philostrate (Mark III-1) was displeased with restraint and within 2 hr of installation had chewed a small hole in lower left portion of front of jacket skirt. During the next 2 hr the hole was considerably

enlarged and the monkey was removed from pod. The jacket was modified so that 3 layers of nylon covered the front of the jacket and skirt. The monkey was tranquilized with Ketamine^(R) for about 2 hr while repairs were done. The subject was reinstalled in pod. Chewing on jacket skirt continued into day 2, and another small hole made in the same area of skirt, but never broke through more than the top layer of fabric.

The silicone gel seal coating was cracked near the edge of the feces hole at end of test. Some of gel had been squeezed out, but damage was relatively minor. The coating may have torn at a weak point or have been pinched against the feces hole edge along a 2-inch line. It may be possible to patch the seat with silicone sealer. Another seat of urethane or Temperfoam^(R) will be fabricated as a backup or replacement for the gel.

It appeared that the side plates of the LBNP template were pushed outward by the subject, thus enlarging the central hole in the template. The waist seal deteriorated between days 2 and 3. This was no doubt due to the monkey pressing strongly upward during struggling against the restraint and enlarging the opening.

(b) #174, Exeter (Mark III): This subject had a large waist, and the arm tray attached to the divider assembly compression ring pressed against the abdomen. This is the probable cause of some skin irritation in this area found at end of test. Different sized, or adjustable, arm trays should alleviate this condition.

Feeder/Waterer

Feeder/waterer signals were recorded for #341, Philostrate by connecting the signal output of the control box to the input (double lead, ungrounded) of a Universal Preamplifier of the Brush strip-chart. The same signals for #174, Exeter were recorded via the instrument console data cable and an Esterline-Angus recorder.

Respiratory Metabolism

The mass spectrometer was outfitted with a 4-way solenoid valve on the upper pod air exhaust lines coming from the 2 pods. This valve was actuated by a timer that switched the mass spectrometer between the 2 pods every 15 min. No problems occurred with this system during the test. Analysis of this data is not complete, and a final evaluation will have to be made regarding the adequacy of the switching frequency between pods.

Pod Temperature

Upper-pod temperatures and mass spectrometer inlet temperature were monitored during this test (3 sensors available). The upper-pod temperatures in the 2 pods were very similar and were observed to range from 26.6 to 27.5°C.

ECG

Only 1 set of ECG leads was available, so heart rate was recorded in the Mark III pod from #174, Exeter in the usual manner. The recording was good throughout the test, with heart rate ranging from 120-160 beats/min. A marked elevation in heart rate occurred during eating and drinking periods. This has been observed in other monkeys in previous tests. In future designs of the feeder/waterer systems it would be advisable to have an off/on switch that would shut off both feed and water when desired, such as during LBNP trials. Exeter showed a pronounced sinus arrhythmia throughout the test and had a respiration rate of 25-30/min as calculated during fast-speed recording.

If a single Brush ECG/heart rate coupler is to be shared between 2 subjects, a special ECG pre-amplifier will have to be developed. This pre-amp would receive as input two 3-lead ECG signals and provide as output 2 single-lead signals with stable D.C. base lines and intact QRS complexes. This would avoid the necessity for individual subject readjustment of the threshold control on the ECG coupler. The single-lead outputs would go to a master timer motor with a 2-position cam to give an appropriate switching frequency between the

two signals. A 3-position selector switch located between the master timer switch and the ECG coupler would allow operation on continuous ECG/heart rate mode for pod A or B, or automatic switching between the 2 pods. Preliminary testing has been done on this concept with initially positive results, but when work begins on designing this system some thought should be given to the comparative cost (material and labor) of purchasing another ECG/cardio-tachometer coupler.

LBNP trials

For this test, the upper and lower pod pressure was monitored by manually changing the pressure lines to the pod to receive LBNP. Also, the lower pod air inlet lines were simply plugged with corks when required in lieu of valves. In principle, however, this system was tested and functioned satisfactorily. The exhaust from the LBNP and ventilation pumps was formerly a common line, but it was discovered that there was considerable back pressure in the ventilation line from the LBNP pump which lowered the output of the ventilation pump. Separate exhaust lines solved this problem.

Trials of 15 min of 20 torr LBNP in the upright position were conducted on both subjects on the 2nd and 3rd days of the test, primarily to test the instrumentation. These trials were conducted during the mass spectrometer calibration sequence beginning at 1000 and were completed in 1 hr by placing the LBNP periods back-to-back. In this test the ECG was recorded from only one subject. Heart rate increased about 15 beats/min in this subject (#174, Exeter). The upper to lower pod air leak during LBNP was exceptionally low in both subjects (especially #341, Philostrate in Mark III-1 pod) for the first test. On the next day #341, Philostrate had a much greater leak, probably due to improper adjustment of the LBNP waist template. It appears that with proper adjustment of the waist seal, and good seals around the couch spacer

bars (recently added nipples to silicone divider seal) and a good support plate "O" ring seal (also a recent improvement in the Mark III pod), this leak can be kept to a minimum (about 25 liters/min).

Latex Urine Catheter

A 0.5 inch I.D. latex surgical drain was placed on the penis of #341, Philostrate for this test for use as a urine catheter. Descriptions of this technique using EPL-fabricated silicone tubing have been included in previous status reports. The latex tubing was snug on the glans but good urine flow was obtained throughout the test. At disassembly it was found that there was mild edema in the penis proximal to the rubber band (probably due to tightness of tubing) and a blister had formed at the tip of the glans (probably due to pooled urine at this point). There were splits along the side of the tubing on the normal fold-line. The pooling of urine and the splitting of the tubing seem to be due to the tendency of the tubing to kink because of its shape and thickness and the short shelf life and low urine compatibility of latex. Perhaps fresh latex tubing of a larger I.D. could be used for short duration collections. Silicone seems to have an advantage for longer duration tests.

Whole Body Potassium Count

This procedure was carried out for 1 hr (both subjects tranquilized with Ketamine HCl^(R)) prior to the return of the monkeys to their cage. The whole-body K count will allow the calculation of lean body mass for use in the expression of the metabolic data.

E. Continuous 14- and 15-day Pod Trials.

In an effort to demonstrate the use of the total pod configuration beyond the 10-day trials which have previously been reported, several tests of a nominally 2-week duration were proposed and carried out during this report period. The first of these tests was conducted for 14.1 days from 29 May to

12 June 1975. The results of this trial are discussed in the following paragraphs.

The monkey #337, Simple, weighing 12.45 kg prior to installation, weighed 12.63 kg on removal for an apparent net gain of 0.18 kg during the test.

Monkey

In general, the monkey tolerated the test very well and was alert and responsive. No restraint jacket chewing occurred. The subject began to develop leg edema on day 4 with an increase on days 5 and 6 (more severe in left leg) which gradually improved on days 7 and 8 and no edema was observed from day 9 through end of test. Upon removal from the pod, the subject showed very mild edema in both ankles with palpation. To evaluate his ability to move his feet and ankles, attempts were made once per day during period when subject had visible leg edema to touch his feet and legs with a probe placed through lower pod air exhaust port. This action produced movement of subject's legs and may have aided in diminishing the extent of edema.

On day 8 it was noticed that the monkey was in full forward position in relation to pod divider subassembly. The monkey remained as far from the back of the couch as possible until end of test. At end of test, it was noted that feces had collected in the back of couch and had filled up the seat. The subject had extensive redness of skin of buttock area and erosion of ventral portion of ischial callosities including slight breaks in skin/callosity interface. A 2 cm² necrotic area was located just ventral to anus. This area bled slightly when cleaned. These areas were in direct contact with feces. A light rash was present on abdomen at LBNP template waist gasket, possible due to subject remaining in full forward position. Subject was able to scratch ears and back of head with feet shortly after return to cage,

although some stiffness in legs was evident.

On day 6 of test the upper pod airflow pump failed and during attempts to substitute an additional pump, monkey was disconnected from airflow for 45 min and began to hyperventilate strongly. Purging of upper pod with a fan corrected this condition and monkey seemed to recover quickly (briefly heart rate was above 150 beats/min).

Mark III Pod

(a) Feeder: Mechanically, the feeder operated satisfactorily throughout test except on days 1 and 8-13, when the metal delivery tube became jammed with pellets one or more times per day.

The LED pellet counting system appeared to be working very well throughout the test. On day 1 the food counter read 192, but by manual count the subject had received only 150 pellets. The total food count electronically was 3,181 (including one estimate due to system being shut off briefly) and manually the count was 3,080. This high count may be due to sensing of food fines.

The electrical signal output to the recorder from the LED counting system did not work at the beginning of the test. On day 12, Mr. P. Haro and Mr. R. Johnson from ARC, during a site visit to EPL, located a short to ground from the feeder signal cable as it exits from the instrumentation console. A temporary modification of the ground cable solved this problem and a good feeder signal output was obtained for the duration of the test.

(b) Waterer: The waterer worked well throughout test. Some water was seen in front of arm tray below waterer nipple on day 1. However, no leakage was observed.

(c) Couch, restraint and divider subassemblies: A small quantity of water was found below the silicone divider seal and LBNP support plate. A small hole was also found in outer edge of divider seal. This hole was

presumably caused by constant pressure from front edge of LBNP template which was in full forward position and water may have leaked through. A slit in front edge of divider seal skirt possibly caused by scissors during cutting of restraint jacket nylon ties during disassembly was noted.

The urethane/silicone seat was completely collapsed in area of ischial callosity contact. This has happened before but was greater than on previous tests.

Considerable staining occurred in couch seat area where it was in contact with feces. The inner coating has started to peel in the seat and foot bar area of the couch. No peeling was observed on pod shell, although mineral deposits have accumulated in the lower section.

The rubber gasket on the compression ring stuck to restraint jacket and peeled off during disassembly.

Urine and Feces Collection

A sponge wicking material (Orion Diagnostica) whose water absorbency characteristics were described in Status Report No. 26, was utilized in the lower pod. This material had been previously tested in the pod with a monkey during a 42.8 hr test (13-15 May 1975). Six sheets (50 x 31 x 0.25 cm) of sponge wicking were washed and rinsed in a 0.1% sodium azide solution and stored in a refrigerator before placement in pod. Urine was first seen above the sponge wicking layer on day 3 of the test. Beginning on day 4, from 525-900 ml (693 ml average) were removed daily via the lower pod air exhaust port with a suction bottle and vacuum pump. The urine was poured into a plastic pail and the suction bottle and tubing rinsed into the pail (10-20 ml distilled water). The pail was then taken to a freezer for storage between collections. A total collection of 7,630 ml of urine was made in this way.

If about 700 ml of urine collects in the lower pod per day, then at the end of day 3 about 2,100 ml of urine would be present in lower pod. This is close to the calculated maximum water holding capacity of the absorbent. The subject in this test consumed about 1,000 ml of water/day and would have an estimated urine output of 850 ml/day, and thus the evaporation of water from the lower pod must be about 150 ml/day (850 minus 700).

At the conclusion of the test it was discovered that a large, mostly dried plug of well-formed feces had collected between the couch feces hole and the couch wall. It appeared that when this plug eventually completely blocked the feces hole, the feces (now becoming loose due to the high protein PMC 5040 diet) was forced back into the couch seat area and eventually all the way up to the urine hole at the front of the couch. The monkey no doubt was forced forward in the couch away from the collecting feces.

Repeated washing with distilled water and scraping with a spatula removed most of the feces from monkey and couch. An attempt was made to collect the feces in a separate plastic pail. The sheets of sponge wicking were used to wash out (with urine) the lower pod shell and the lower half of couch. Approximately 1 liter of distilled water was added to the lower pod during this rinsing procedure. The sponge wicking was squeezed out and placed in a plastic bag for later rinsing into the excreta collection. The total excreta collection was stored for analysis along with a 10% diet sample of PMC 5040 pellets.

The feces build-up problem in the Mark III pod appears to be chronic in tests of longer duration. Two previous tests in the Mark III pod have been conducted for longer than 5 days duration. Each test was 10 days long and in one evaluation (#341, Philostrate, 4-14 Feb 74) feces build-up on and behind the couch was noted. During both of these tests several LBNP trials

were conducted, which may have minimized the feces build-up (during supine tilt urine pours over feces and then during upright tilt is washed into bottom of pod).

An attempt has been made in design of Mark III-1 pod to increase room behind couch for feces to fall away from couch. A test of long duration with this pod (10-14 days) should indicate whether this problem has been ameliorated.

Respiratory Gas Exchange Subsystem

(a) The mass spectrometer operations during the trial were routine and uneventful. Daily calibration checks indicated stable base lines and sensitivities in the signal outputs for the duration of the test.

(b) A failure of the upper-pod ventilation pump occurred at approximately 0100 PST, 4 June 1975, 135 hr into the test. The probable cause was subsequently determined to include burned-out bearings in the motor. The failure was discovered at approximately 0730 PST, and the upper pod was purged intermittently with fresh air by means of an auxiliary blower fan until a replacement pump could be installed. Nominal flow through the upper pod was restored at approximately 1000 PST.

Surprisingly, the animal did not appear to be in distress at the time the problem was first noted. It is suggested that the MS sample flow pump provided small but sufficient ventilation during the early morning hours. An experiment during the remedial procedures, with the upper pod isolated from the MS pump, revealed that some 45 min following the last purging with fresh air, the F_{CO_2} in the upper pod had risen to a level which caused a marked hyperventilation in the animal. The latter observation is taken to mean that except for the small ventilation provided by the MS pump, the animal would have been in serious difficulty in the approximately 6.5 hr between upper-pod ventilation pump failure and discovery. A secondary ventilation system with provision

for automatic switch-over would appear to be a desirable addition to the system.

The substantial job of data reduction and calculation of the hour-by-hour respiratory gas exchange is expected to require approximately 1 man-month for completion.

Upper/Lower Pod Temperature

Upper and lower pod temperatures were recorded in the morning and afternoon each day during the test. Upper-pod temperature averaged 26.7°C (25.5°-28.4°C) and lower pod temperature averaged 24.7°C (23.7°-25.9°C) during the test.

ECG

The ECG signal and the cardiometer output signal remained good until day 6 of the test. Beginning this day an increase in base-line noise (60 Hz) began to deteriorate the cardiometer record and only 10-50% of each 24-hr record contained readable heart rate data for the remainder of the test. The R wave could be identified in daily ECG records at fast paper speed throughout test. Upon electrode removal, very little of the electrode gel (pediatric size silver/silver chloride electrodes and Biogel^(R) contact medium) was present. A mild rash was produced on skin area covered by the ECG foam pads.

The second of the proposed extended tests was of 15 days duration, conducted from 25 June to 10 July 1975. The main objective was to demonstrate the feasibility of 3-day excreta collection periods with the monkey pod, and a schedule is shown in Table 2. The results of this trial are discussed in the following paragraphs.

Monkey

The subject, #341, Philostrate, tolerated the test very well. Mild leg edema was noted on day 6 through day 15 of test. There was some lessening

of swelling from day 12 to 15. Subject operated waterer and feeder well beginning at 1500 on day 1. On days when subject was tranquilized (Ketamine HCL, 50-70 mg I.M.) for removal from pod and collection of excreta, subject began operating feeder and waterer at about 2 hr after reinstallation in pod. Insertion weight was 11.08 kg, with a weight on removal of 11.74 kg.

Mark III Pod

(a) Feeder: The feeder operated satisfactorily mechanically throughout the test, except for the usual problems with pellets becoming stuck in the metal delivery tube due to accumulation of food fines. The LED pellet counting system was observed once to miss counting a delivered pellet and, on another occasion, to count an undelivered pellet. However, there was good agreement (less than 1% difference) between the total electronic count (3,102) and the manual count (3,074). The electrical signal output from the LED to the recorder (Esterline-Angus) was good throughout.

(b) Waterer: The waterer worked well throughout the test.

(c) Couch, restraint and divider subassemblies: The subject chewed and tugged on the jacket and skirt on days 1-5. By day 3, the subject had chewed a small hole in front of jacket. A patch was sewn over hole on this day, but it was subsequently chewed off. On day 6, the jacket was removed and a new jacket with double nylon panels on front of jacket and skirt was put on the subject. No chewing occurred after this change. No damage occurred to divider seal, but one ECG lead was chewed off on day 5 prior to the jacket change.

The original foam-type waist seal was destroyed by the subject reaching through the jacket hole, and was replaced on day 6 by a new fabric-type seal. This waist seal (elastic fabric with coating on inner surface of 92-009 silicone) remained in place over the divided seal sleeve until sometime

between days 12-15. An LBNP test may have pulled the sleeve out from under the seal on the 14th day. A silicone coating that is more "tacky" has since been applied to the waist band with no recurrence of this problem.

The couch seat area was very clean after removal of the subject. There was a heavy coating of mineral deposits on foot portion of lower couch.

Urine and Feces Collection

The 3-day excreta collections were done following the schedule shown in Table 2. Pod disassembly began at about 1030, and reassembly was completed before 1200 on each collection day.

The procedures followed for all but the 1st collection day were identical. Most of the urine in the lower pod was collected in a graduated suction bottle before the monkey was removed. This volume plus 50 ml rinse water was placed in a plastic dishpan. The approximate urine volumes (less rinse water) ranged from 1,700-2,100 ml for each 3-day collection. The feces were washed off the monkey and couch into the lower pod using a spatula, gloved finger, and water. The formed feces were lifted from the lower pod to the dishpan with a spatula and the remaining contents wiped out with a single Orion Diagnostica sponge (pre-treated with 1% sodium azide solution, but rinsed and squeezed dry twice in 1 liter volumes of distilled water before use).

From 50-350 ml of distilled water were used as a rinse during each feces collection. Prior to placing the excreta (in dishpan) in the freezer, the sponge wicking material used to wipe out the lower pod was rinsed twice and squeezed dry in 1-liter volumes of distilled water, and these rinsings were added to the collection.

The weight of each excreta collection (not including rinse water) ranged from 2.2-2.6 kg. The total weight for the 5 collections was 12.1 kg. Assuming a daily feces output of 50 g (refer to Status Report No. 5), this

would give 11,350 ml of urine and 750 g of feces. This would be a daily urine volume of 750 ml. If one assumes a daily urine output of 850 ml, then perhaps 100 ml of water was evaporated daily from the lower pod.

The first excreta collection (28 June) differed from the last 4 only in that a sponge was placed in the bottom of pod during the 3-day collection and the excreta were placed in a double plastic bag lining the plastic dishpan. The simplified procedure described above was used thereafter.

A 10% diet sample of PMC 5040 pellets, and the 5 frozen excreta collections, were stored and will be analyzed in the near future. The sponge wicking material was washed with soap, soaked in a bleach solution, treated with 1% sodium azide, and stored in a refrigerator. These sponges are beginning to show signs of wear.

Respiratory Metabolism

The calibration of the mass spectrometer on excreta collection days was accomplished during the collection period, thus minimizing the period when data were not collected. On the remaining days the calibration was done at the usual time.

ECG

Miniature ECG leads were placed on subject on day 1 and functioned adequately until day 5. On the 6th day, a lead had been chewed off (probably drawn out through small hole in jacket), and a new set of ECG leads (adult size) were placed on subject. These worked only until day 7 when a signal could no longer be obtained. Due to lack of foam ECG pads, no attempt was made to examine leads until end of test. At final removal of subject, it was found that the leads were partially removed from the chest wall (probably due to chewing of monkey) and the gel contact medium was dried out. Skin beneath leads was flaky with about 1/8-inch of hair growth.

Support Console

One of the two rubber support straps on the upper-pod airflow pump broke and both pieces of tubing showed signs of aging due to high heat generated by the pump. New tubing was used to suspend pump.

Upper/Lower Pod Temperatures

Upper-pod temperatures (taken in A.M. and P.M.) averaged 26.5°C (25.0°-28.0°C) and lower pod temperatures averaged 24.2°C (23.1°-25.9°C). The daily recorded temperatures are shown in Table 3. These values are very similar to those obtained during a previous 14-day pod trial with #337, Simple (29 May 1975).

LBNP Trials

One brief test at 10 and 20 inches of water pressure in the upright position indicated a poor seal between upper and lower pod. This was done on the 14th day of test, and the problem was attributed to inadequate friction between the divider and waist seal silicone materials. This problem has been overcome.

Conclusions

This test indicates that 3-day excreta collections in the Mark III pod are feasible. Removal of the tranquilized subject, the collection of essentially all excreta, and reinstallation of the subject was accomplished in about 1 hr using 3 people. This technique avoided the feces build-up problem and the associated damage to the subject noted during the previous 14-day test (29 May 1975). It allowed access to the monkey to change ECG leads, jackets, waist seal, make foot-bar adjustments, and evaluations of the subject's physical condition. It would also allow access to the subject for taking urine and blood samples.

II. PHYSIOLOGY

A. *Pod Nutrient Balance.*

The pod diet for the monkey interface tests during this report period consisted of Purina Monkey Chow (PMC) 5040 food tablets to which the subject had access at all times. However, water was limited to the amount of 1,000 ml in a single offering each day. The acceptability of this regimen was successfully demonstrated in tests of 14.1 and 15.0 days duration. The intakes of food and water together with weight change data are shown in Table 4-A and B. Test conditions and the results associated with bio-instrumentation were discussed under Section II.E of this report.

During the total period of the 14.1-day test with #337, Simple, drinking activity was recorded on a strip chart. Continuous feeding activity was not recorded until an electronic deficiency was corrected during 10 June 1975. However, daily morning and afternoon check points with manual recording of food and water consumption were obtained throughout the trial. A periodic summary of food and water consumption is shown in Table 5.

For the portion of the day starting at a mean time of 1611 \pm 0039 and ending at 0846 \pm 0016, covering a period of 16.04 \pm 0.35 hr, the average number of food tablets consumed was 42 \pm 14, or 2.6 \pm 0.8 per hr. For this same period, 157 \pm 78 ml of water at a rate of 10.1 \pm 5.3 ml per hr were consumed.

For the balance of the 24-hr period, that is from a mean time of 0846 to 1600, the food intake averaged 174 \pm 18 tablets, or a rate per hr of 23 \pm 3 tablets. Water consumed during this period averaged 890 \pm 49 ml at a rate of 120 \pm 10 ml per hr. During any single 10-min period of drinking activity 191 \pm 20 ml of water were consumed.

A periodic summary of food and water consumption by #341, Philostrate during the 15-day Mark III pod test from 25 June to 10 July 1975 is shown in Table 6. As continuous activity for both eating and drinking were recorded, a percentage figure for the time involved with these activities is included in the table.

In both of these trials the majority of food and water ration was consumed during daylight hours. Further, it appears that 3 or 4 days are required before these activities are stabilized.

B. Pod Respiratory Gas Exchange.

The operational aspects of the 14.1 day pod test of #337, Simple have been reported under Section II.E of this report. Despite the problems noted, 800 ft of strip chart recordings were read from which 16,000 individual data points were tabulated for the hourly oxygen consumption and carbon dioxide production figures indicated in Tables 7 to 9. Further, as shown in Table 10, a highly significant difference between the night and day cycle indicates the existence of biorhythmicity in the respiratory gas exchange.

The reduced data for the 15-day trial (#341, Philostrate) which included 3-day excreta collection periods, are shown in Tables 11 to 13. Three-day means for respiratory gas exchange are shown in Table 14. The variance from the mean data for the first 3 days may be an indication of the switch-over from cage to pod conditions or the change in diet from the regular 15% protein Purina Monkey Chow to the 22% protein 5040 PMC ration.

The results of the 2-pod trial conducted from 29 July to 1 August 1975 are shown in Tables 15 to 18. Body cell mass determinations were made on these monkeys with the use of the whole body potassium counter following removal from the pods. Respiratory gas exchange data as a function of body weight and body cell mass for the 2 monkeys are summarized in Table 19.

C. Monkey Cardiovascular Studies.

Post-surgical chronological progress for pig-tailed monkey #396, Lovel, implanted with a NASA/ARC cardiovascular telemetry unit was considered under Section I.B of this status report. Reliable heart rates were recorded throughout this period. However, quantitative left ventricular and aortic pressures utilizing the original bench test calibration were difficult to determine accurately for most of the trials. The unanesthetized monkey respiratory and cardiovascular systems were challenged by "dry asphyxia". This method consisted of placing a surgical glove over the mouth and nares of the subject. The relative changes observed in vascular pressures and heart rate were of the similar magnitude as that previously recorded for male pig-tailed monkeys at EPL-UCB. In addition, when lights were dimmed in the experimental area and the monkey was left quietly alone, heart rate, systolic, diastolic, and mean pressures were decreased with no apparent shift in pulse pressure. These observed physiological changes are precisely what one might predict under the particular environmental circumstances. The recording of these cardiovascular parameters was also accomplished with the unanesthetized subject restrained within the pod configuration without attenuation of signal output. It is anticipated that the information derived from these trials will result in improved modification of the total T/M system to provide sufficient electronic stability for the acquisition of reliable quantitative data.

Continuous heart rate data were also recorded from external ECG electrodes on the pod trials reported in Section I.E of this report. The hourly means have not yet been compiled. Cardiovascular responses resulting from the application of LBNP were of the same order as those considered in previous status reports.

A preliminary summary of T/M cardiovascular data obtained during the report period is shown in Table 1.

D. Monkey Thyroid Function

Status Reports No. 25 and No. 26 discussed the development of radio immunoassay procedures utilized for the detection of thyroid related protein hormones. The accuracy of these analyses has been demonstrated and sources of error eliminated. Serum samples from 6 adult male pig-tailed monkeys stored at freezer temperatures for 5 months have been analyzed during this report period. A preliminary summary of the results obtained from a varying number of samples for each parameter is shown in Table 20. These assays included total and free T₄ in µg/100 ml of blood serum, total and free T₃ in ng/100 ml of blood serum and TSH in µ units/ml serum. All the monkeys have been maintained under identical cage conditions at EPL, UCB campus. Following establishment of base-line control values, it is planned to transport the animals to high altitude at the Barcroft Laboratory, White Mountain Research Station.

E. Monkey Blood Oxygen Transport

As indicated in Status Report No. 26, the procedures for determining all the desired parameters of venous blood samples and buffer suspensions of erythrocytes except O₂ content were successfully developed. During this report period, technical problems associated with the determination of O₂ content under incubation conditions at 38°C, 34 torr O₂ and 42 torr CO₂ were overcome. O₂ content was determined on samples of venous blood at 36 min and 70 min following the initiation of the incubation period.

It is planned to complete sea level studies on 6 monkeys and then to transport them to the Barcroft Laboratory of the White Mountain Research Station during the next report period.

F. *Monkey Growth and Reproduction*

Body weights and body cell mass estimation with the use of a whole body scintillation counter have been continued on both male and female pig-tailed monkeys of known age. In addition, these parameters have been obtained on long-term residents of the monkey colony whose precise age cannot be determined. In conjunction with the activity it is planned to survey the colony records of all the pig-tailed monkeys that have been admitted to the colony since the original animal of that species was obtained on 27 January 1961. This compilation should provide some additional information in regard to growth characteristics of feral monkeys after their removal from their native habitat.

At the conclusion of this report period, weight records, roentgenographic data and body cell mass data have been collected on colony-raised male and female pig-tailed monkeys from birth to over 11 years of age, encompassing a weight range of 0.5 to 12.5 kg.

III. BIOCHEMISTRY

A. *Monkey Pod Excreta Analyses*

Metabolic balance studies require accurate measurements of each subject's food intake and excreta. Analytical data on the amount of food consumed and its chemical composition can be readily obtained. To obtain a similar degree of accuracy in chemical analysis on the monkey excreta, careful precautions must be taken to avoid any loss of valuable constituents. Difficulties encountered when the animal's metabolism is studied on the earth's surface are compounded when such a monkey is placed in a weightless environment.

Large quantities of absorbing material are required. The material originally used for this purpose (Eaton-Dikeman absorbent paper) did not

significantly affect the analytical results; however, its bulk, perhaps 3 or more times the dried weight of the excreta, was a major obstacle in good analytical technique. Even so, the amount of absorbent which was used was inadequate in its urine holding capacity. Eventually, a new absorbent was tried. This was a white sponge textured material manufactured by Orion Diagnostica of Finland. The material has a somewhat larger water-holding capacity than the Eaton-Dikeman paper. However, its main advantage is its ability to retain textural integrity while readily releasing the absorbed contents. As a result, we can analyze the excreta only, undiluted by a mass of more-or-less inert material.

During this report period, we used the absorbent paper for a 5.0-day test and the sponge material for a 14.1-day test. The analytical results are shown in Tables 21 and 22. Even though the output-input ratio is essentially the same in the 2 experiments, using the same animal, the analysis itself was much simpler to carry out in the experiment in which the sponge was used.

At present, the Orion Diagnostica sponge appears to be the best material for absorbing and holding monkey excreta at 1 g and in weightlessness. However, it is available only in Finland and is expensive when used only one time in routine laboratory experiments. If it is used several times, the sponge, which is originally white, eventually disintegrates because strong bleaches must be used for stain removal.

A third absorbent is a sponge material made from cellulose derived from wood by-products. It is available in this country from American Sponge and Chamois, Inc., Los Angeles, California. This cellulose sponge is inexpensive, readily available, and has the highest water holding capacity of the absorbents so far studied. It is available in relatively thin flexible sheeting which

conforms readily to the contours of our pod, and it swells to many times its original thickness as a result of moisture absorption. The disadvantages are in its impurities which may affect the analyses.

Random samples of unused sponge were analyzed to determine what possible elements it might have which would interfere with the metabolic study results.

1. Ashing in a crucible of 18.4 g yielded a red powder weighing 0.1 g or 0.54% ash.
2. Spectrographic analysis of both the ash and native sponge showed a high content of iron and calcium.
3. X-ray analysis yielded very high iron and somewhat less calcium, with traces of copper, zinc, arsenic, lead, strontium and chromium.
4. Atomic absorption enabled us to actually estimate the amount of the following elements:
 - a) Iron = 0.30% when sponge was ashed at 600°C
 Iron = 0.0025% when extracted with hydrochloric acid
 Iron = 0 when extracted with water
 - b) Calcium = 0.053% when ashed at 600°C
 Calcium = 0.056% when extracted with hydrochloric acid
 Calcium = 0.043% when extracted with water
 - c) Sodium = 0.050% when decomposed in sulfuric acid
 Sodium = 0.008% when ashed at 600°C
 Sodium = 0.0051% when extracted with hydrochloric acid
 Sodium = 0.0045% when extracted with water
 - d) Magnesium = 0.0003% when ashed at 600°C
 - e) Potassium = not detected in sulfuric acid digestion
 - f) Chloride = 0.068% when ashed at 600°C (in presence of K_2CO_3)
 Chloride = 0 when extracted with water
 - g) Nitrogen = 0.593% in sulfuric acid digestion
 Nitrogen = 0.014% in either water or acid extract
 - h) Phosphorus = 0 in either water or acid extract

Iron, calcium, sodium and chloride total 0.47%. Since the total ash equals 0.54%, these elements account for most of the ash, or 87% of total ash. Trace elements (such as sulfur) would make up the difference.

A nitrogen level of almost 0.6% shows a very substantial amount of organic matter (nitrogen is lost on ashing or burning, but not in acid digest).

Extraction alone removes only 2% of total nitrogen. This may not interfere with our experiment if all the "loose" or "unbound" nitrogen can be washed out.

Our next step must be a repeat analysis on well-extracted sponges.

Nitrogen Analysis of Monkey Excreta

For some time we noted that the intake of elemental nitrogen is far greater than its output. Since the monkey's weight did not change substantially for the duration of the experiment, he could not possibly retain what was at times as much as 85% of his nitrogen intake (Tables 21 and 22). Thus, the nitrogen loss must have taken place after excretion. Through a systematic search, we found that the "lost nitrogen" escaped by sublimation during the freeze-drying process. While the monkey is in the pod, the pH of the urine rises, probably due to accumulation of ammonia by conversion from urea. The analysis of exhaust gases from the pod showed negligible amounts of ammonia escaping. However, the liquid contents in the pod did contain high concentrations of ammonia and urea.

Necessary precautions will have to be taken to prevent loss of this extremely important element. One obvious method is to maintain a low pH while the excreta accumulates and is stored prior to freeze-drying.

Testing of Analytical Methods

To assess the quality of our analytical results, we acquired from the National Bureau of Standards bovine liver and orchard leaves, with accompanying analyses. Samples of these materials were prepared for analysis in a similar fashion as the monkey excreta. In Table 23 the results obtained in this laboratory are compared with those reported by the NBS. Our results appear to fall within the limits of analytical accuracy given by the NBS.

Sample size is an important factor for a particular analysis and for a given element. When multiple elements are analyzed in a single sample, some constituents may be at a concentration near or below the sensitivity of the method, while others may be in excess. In monkey excreta, constituents present in very low or very high concentrations are subject to serious analytical errors. In future analyses, several sample sizes will be used so that all constituents analyzed fall within the limits of the method.

B. *Electrophoresis*

Electrophoretic separation of creatine phosphokinase (CPK) isoenzymes in human blood. The isoenzymes of CPK in human blood can now be determined by electrophoresis on cellulose acetate rather than on gels. Until recently these isoenzymes could be visualized only by fluorescence, due to conversion of nicotinamide adenine dinucleotide (NAD) to the reduced form (NADH). NADH produces a brilliant bluish-green fluorescence when activated with a 350 nm wavelength source. The wavelengths were not easy to view, study and measure because an ultraviolet light source was required. However, a colorimetric procedure has been worked out which permits detection of the isoenzymes of CPK in the visible spectrum. The visible blue color is produced by insoluble formazan derived from the conversion of nitroblue tetrazolium.

Standard isoenzymes and the required substrates were obtained courtesy of DADE, Division of American Hospital Supply Corp. of Miami, Florida.

There are 3 isoenzymes of CPK. These are known as the MM, MB, and BB bands or fractions. The MM isoenzyme is normally present in serum and is known as the muscle type. The MB isoenzyme is characteristic of heart tissue and its appearance in serum is considered a specific indication of myocardial infarction. The BB isoenzyme, which is known as the brain type, is also normally not present in serum. Its appearance in serum is presently equivocal.

Using an electrophoretic technology recently developed in this laboratory for the isoenzymes of phosphoglucomutase (B. W. Grunbaum, J. Forens. Sci. Soc., 14: 151-157, 1974), 16 specimens can be similarly analyzed simultaneously for CPK on a single cellulose acetate membrane between 30 and 60 min. Since total CPK activity has been used in this laboratory for clinical evaluations of both humans and monkeys, the determination of the individual isoenzymes of CPK should now provide supportive data on the physiological condition of specific organs or tissues.

IV. COLONY

A. *Clinical Health*

Two new acquisitions, #427, Grumio and #428, Biondello, completed their quarantine at the UCB Division of Animal Resources and were admitted to the EPL colony on 13 February 1975. Although they cleared all the quarantine procedures, both of these adult male pig-tailed monkeys developed problems of diarrhea. While treatment for the condition was carried out, it remained in evidence throughout this report period. However, their general condition in regard to weight and pelage was maintained within normal limits. No other residents of the colony exhibited similar symptoms.

In line with the reasons set forth in Status Report No. 26 in regard to available personnel, the entire colony was not tested for Tuberculin reaction. Eight selected representatives of varied age, sex and cage location within the monkey colony were tested and proven to be negative during the months of February and March 1975.

B. *Census*

The only additions to the monkey colony were those mentioned in the previous paragraph IV.A of this report. As a result of the progress maintained in the monkey pod construction and testing (see I.A,D,E), the

demonstration of feasibility in maintaining a totally implanted cardiovascular telemetry unit in a male pig-tailed monkey (see II.B) and pending the action in regard to the CV-990 flight (see II.C), #337, Simple, was shipped to NASA/ARC on 17 July 1975. This monkey has been utilized in numerous pod tests, participated in the CVT's at ARC and MSFC during 1974, and successfully completed a pod trial of 14 days duration during this report period. Thus he should prove to be the best candidate for surgical preparation with an improved T/M implant to satisfy the requirements of a proposed experimental flight.

At the conclusion of this report period 31 pig-tailed monkeys comprised the colony located at EPL. A census summary is shown in Table 24.

Table 1. Preliminary T/M (Unit 101T21B) cardiovascular data from the adult male pig-tailed monkey #396, Lovel

Day Surgery(+)	Date	Body Wt (kg)	Heart Rate Range (beats/min)	Respiratory Rate Range (breaths/min)	Remarks (hours indicate restraint time in chair)
Surgery	26 Feb 75	13.50	110	--	Anesthetized on surgical table. Closed chest.
S+5	3 Mar 75	13.20	154-177	--	1300-1600
S+8	6 Mar 75	13.05	160-174	--	1045-1355
S+12	10 Mar 75	12.60	156-171	20-28	1015-1230
S+15	13 Mar 75	12.65	150-175	18-30	0945-1245 (anesthetized at 1300 for T/M unit calibration check)
S+22	20 Mar 75	12.30	156-162	20-25	0930-1315
S+27	25 Mar 75	12.05	158-180	25-39	0930-1245 CV system challenged
S+29	27 Mar 75	12.20	140-160	20-22	0930-1240 CV system challenged
S+33	31 Mar 75	12.25	140-160	19-22	0930-1250
S+36	3 Apr 75	12.35	138-156	18-23	0930-1300
S+40	7 Apr 75	12.40	138-150	18-21	0930-1115
S+43	10 Apr 75	12.40	130-150	18-20	0930-1150
S+47	14 Apr 75	12.10	145-160	20-23	0930-1245
S+50	17 Apr 75	12.35	135-145	19-20	0930-1145
LVP torr 145/0, 135/0 A torr 145/90, 135/85 (interpretation from chart records and original calibration data)					
S+54	21 Apr 75	12.35	150-159	19-24	0930-1330
S+56	23 Apr 75	12.33	135-160	18-22	0930-1430 Recording from monkey in EPL Mark III pod. NASA Hq visitors.

(continued)

Table 1 (continued)

Day Surgery(+)	Date	Body Wt (kg)	Heart Rate Range (beats/min)	Respiratory Rate Range (breaths/min)	Remarks (hours indicate restraint time in chair)
S+61	28 Apr 75	12.15	130-160	18-22	0945-1205
S+65	2 May 75	12.39	130-165	17-23	1000-1430 Recording from monkey in EPL Mark III pod. USSR visitors.
S+78	15 May 75	12.50	130-155	18-24	0930-1130
S+85	22 May 75	12.70	135-160	18-24	1400-1500
S+92	29 May 75	12.65	135-160	18-23	0945-1055
S+99	5 Jun 75	13.07	135-160	18-23	1240-1515
S+113	19 Jun 75	13.20	135-160		0930-1100
S+118	24 Jun 75	12.87	85-150		(anesthetized for T/M unit checkout) 0830-1400
S+128	3 Jul 75	12.93	140-170	18-23	0930-1100
S+141	16 Jul 75	13.10	140-160		1000-1115
S+149	24 Jul 75	13.15	140-155	18-24	1130-1430

Table 2. A 15-day monkey-pod schedule for sequential 3-day excreta collections.

W	25 June	1200	Start
Th	26	1200	
F	27	1200	
Sa	28	1200	1st collection
Su	29	1200	
M	30	1200	
Tu	1 July	1200	2nd collection
W	2	1200	
Th	3	1200	
F	4	1200	3rd collection
Sa	5	1200	
Su	6	1200	
M	7	1200	4th collection
Tu	8	1200	
W	9	1200	
Th	10	1200	5th collection

Table 3. Upper and lower pod temperatures recorded during a 15-day trial with the pig-tailed monkey #337, Simple.

Date of Observation	Time of Observation	Upper Pod Temp. °C	Lower Pod Temp. °C	Temp. Difference Upper/Lower Pod °C
25 Jun 75	1115	25.0	23.1	1.9
26 Jun	1615	27.4	25.0	2.4
27 Jun	0815	26.3	23.4	2.9
28 Jun	0825	26.2	23.6	2.6
29 Jun	0910	26.7	24.4	2.3
30 Jun	0812	26.6	24.2	2.4
30 Jun	1345	27.1	24.9	2.2
1 Jul	0808	25.6	23.2	2.4
1 Jul	1400	27.0	24.8	2.2
2 Jul	0840	25.9	23.6	2.3
2 Jul	1718	26.9	24.7	2.2
3 Jul	0815	25.7	23.5	2.2
3 Jul	1315	26.3	24.4	1.9
4 Jul	0840	25.9	23.8	2.1
5 Jul	0900	26.1	23.8	2.3
6 Jul	0900	26.1	24.1	2.0
7 Jul	0815	26.3	23.9	2.4
7 Jul	1630	28.0	25.8	2.2
8 Jul	1655	27.9	25.9	2.0
9 Jul	0815	26.5	24.3	2.2
10 Jul	0820	26.4	24.1	2.3

Table 4-A. Weight changes and nutrient intake for the 14.1-day pod test (1100 29 May 75 - 1345 12 Jun 75).

Monkey No.	Body Weight (kg)	Food Consumption (no. tablets)		Water Consumption (ml)	
		Total	Per Day	Total	Per Day
337	At installation	12.45			
	At removal	<u>12.63</u>			
	Net gain	0.18	3,080	218	14,685
					1,040

Table 4-B. Weight change and nutrient intake for the 15.0-day pod test (1100 25 June 75 - 1100 10 July 75)

Monkey No.	Day of Test	Body Wt. (kg)	Food Consumption (no. tablets)		Water Consumption (ml)	
			3-day Total	Per Day	3-day Total	Per Day
341	1	11.08*				
	3	11.75	415	138	2,310	770
	6	11.70	676	225	3,000	1,000
	9	11.69	563	188	3,000	1,000
	12	11.91	705	235	3,000	1,000
	15	11.74	<u>754</u>	251	<u>3,770</u>	1,257
		Total	3,113		15,080	
		Average		207		1,005

* Weight determined prior to consumption of daily food and water.

Table 5. Summary of periodic food and water consumption of #337, Simple in a Mark III pod test of 14.1 days.

Period of Observation	Duration of Period (nearest 0.5 hr)	Food Consumption 5040 PMC Tablets		Water Consumption	
		Total (no.)	Avg/hr (no.)	Total (ml)	Avg/hr (ml)
1000 29 May - 1620 29 May	6.5	96	14.8	650	100
1620 29 May - 0810 30 May	16.0	96	6.0	350	22
0810 30 May - 1600 30 May	8.0	199	24.9	650	81
1600 30 May - 0843 31 May	17.0	75	4.4	350	21
0843 31 May - 1832 31 May	10.0	93	9.3	575	57
1832 31 May - 0835 1 Jun	14.0	86	6.1	925	66
0835 1 Jun - 0804 2 Jun	23.5	202	8.6	760	32
0804 2 Jun - 1400 2 Jun	6.0	73	12.2	580	97
1400 2 Jun - 0820 3 Jun	18.5	151	8.2	420	23
0820 3 Jun - 1607 3 Jun	8.0	166	20.7	1,000	125
1607 3 Jun - 0830 4 Jun	16.5	96	5.8	0	0
0830 4 Jun - 1630 4 Jun	8.0	129	16.1	1,000	125
1630 4 Jun - 0825 5 Jun	16.0	0	0	0	0
0825 5 Jun - 1620 5 Jun	8.0	105	13.1	1,000	125
1620 5 Jun - 0820 6 Jun	16.0	0	0	0	0
0820 6 Jun - 1625 6 Jun	8.0	172	21.5	1,000	125
1625 6 Jun - 0950 7 Jun	17.5	34	1.9	0	0
0950 7 Jun - 1555 7 Jun	6.0	278	46.3	1,000	167
1555 7 Jun - 0900 8 Jun	17.0	0	0	0	0
0900 8 Jun - 1800 8 Jun	9.0	241	26.8	1,000	111
1800 8 Jun - 0820 9 Jun	14.5	0	0	0	0
0820 9 Jun - 1750 9 Jun	9.5	227	23.9	1,000	105
1750 9 Jun - 0808 10 Jun	14.5	0	0	0	0
0808 10 Jun - 1645 10 Jun	8.5	269	31.6	1,000	118
1645 10 Jun - 0810 11 Jun	15.5	0	0	0	0
0810 11 Jun - 1630 11 Jun	8.5	236	27.8	1,000	118
1630 11 Jun - 0812 12 Jun	15.5	11	1.0	0	0
0812 12 Jun - 1245 12 Jun	4.5	156	34.7	1,000	222

Table 6. Summary of periodic food and water consumption of #341, Philostrate in a Mark III pod test of 15.0 days duration.

Period of Observation	Duration of Period (nearest 0.5 hr)	Food Consump. 5040 PMC Tabs.		% of Total Time Eating	Water Consump.		% of Total Time Drinking
		Total (no.)	Avg/hr (no.)		Total (ml)	Avg/hr (ml)	
1030 25 Jun - 1600 25 Jun	5.5	2	--	3.3	40	7	3.0
1600 25 Jun - 0800 26 Jun	16.0	21	1.3	2.8	270	17	2.8
0800 26 Jun - 1600 26 Jun	8.0	66	8.3	14.6	850	106	48.3
1600 26 Jun - 0800 27 Jun	16.0	60	3.8	7.3	150	9	3.1
0800 27 Jun - 1600 27 Jun	8.0	143	17.9	31.3	1,000	125	22.9
1600 27 Jun - 0830 28 Jun	16.5	82	5.0	10.9	0	0	0
0830 28 Jun - 0900 29 Jun	24.5	275	11.2	22.4	1,000	41	8.8
0900 29 Jun - 0800 30 Jun	23.0	201	0.9	13.8	1,000	44	10.3
0800 30 Jun - 1630 30 Jun	8.5	163	19.2	19.6	1,000	118	19.6
1630 30 Jun - 0800 1 Jul	15.5	55	3.6	5.4	0	0	0
0800 1 Jul - 1600 1 Jul	8.0	104	13.0	22.9	1,000	125	25.0
1600 1 Jul - 0830 2 Jul	16.5	0	0	0	0	0	0
0830 2 Jul - 1600 2 Jul	7.5	222	29.6	26.5	1,000	133	24.4
1600 2 Jul - 0800 3 Jul	16.0	0	0	0	0	0	0
0800 3 Jul - 1630 3 Jul	8.5	192	22.6	33.3	1,000	118	19.6
1630 3 Jul - 0830 4 Jul	16.0	43	2.7	5.2	0	0	0
0830 4 Jul - 0900 5 Jul	24.5	229	9.4	17.0	1,000	41	8.8
0900 5 Jul - 0900 6 Jul	24.0	228	9.5	11.8	1,000	42	9.0
0900 6 Jul - 0800 7 Jul	23.0	238	10.4	15.2	1,000	44	7.3
0800 7 Jul - 1630 7 Jul	8.5	186	21.9	37.3	1,000	118	19.7
1630 7 Jul - 0800 8 Jul	15.5	84	5.4	7.5	0	0	0
0800 8 Jul - 1600 8 Jul	8.0	133	16.6	41.7	1,000	125	16.7
1600 8 Jul - 0800 9 Jul	16.0	62	3.90	5.2	0	0	0
0800 9 Jul - 1630 9 Jul	8.5	191	22.5	21.6	1,000	118	33.3
1630 9 Jul - 0830 10 Jul	16.0	53	3.3	10.8	0	0	0
0830 10 Jul - 1030 10 Jul	2.0	80	40.0	41.6	770	385	41.6

Table 7. Oxygen consumption (liters/hour, STP) of monkey #337, Simple during 14.1-day pod trial.

Time	29 May 1975	30 May 1975	31 May 1975	01 Jun 1975	02 Jun 1975	03 Jun 1975	04 Jun 1975	05 Jun 1975	06 Jun 1975	07 Jun 1975
0030	--	4.33	4.75	4.58	4.65	6.75	5.30	5.18	4.75	5.08
0130	--	4.87	5.30	4.88	5.40	6.10	--	5.04	4.90	4.88
0230	--	5.41	4.90	4.73	5.00	5.60	--	5.18	5.74	4.48
0330	--	4.43	4.70	4.73	4.85	5.90	--	5.09	4.85	4.38
0430	--	5.02	5.10	4.73	4.90	5.05	--	4.89	5.20	5.18
0530	--	4.53	5.25	4.68	5.05	5.25	--	4.45	4.36	4.48
0630	--	5.90	--	--	5.90	6.15	--	5.38	4.75	--
0730	--	5.22	5.28	6.30	--	--	--	4.74	5.10	5.00
0830	--	--	5.38	5.45	5.75	6.20	--	--	5.64	5.40
0930	--	5.99	5.33	5.65	5.85	6.40	--	6.04	--	4.65
1030	--	5.35	5.93	4.75	5.20	6.10	6.26	5.64	6.08	6.44
1130	--	5.25	5.63	4.55	5.95	5.75	5.62	4.80	5.53	5.00
1230	4.77	5.89	4.73	5.25	5.65	6.10	6.31	5.89	4.93	5.99
1330	4.23	5.10	5.68	6.00	5.35	6.70	6.16	5.40	5.68	5.25
1430	4.92	5.64	5.33	5.95	5.80	5.70	6.55	4.95	5.78	5.54
1530	4.33	5.94	5.68	5.05	5.75	6.20	6.01	5.84	6.08	5.64
1630	5.31	5.69	5.78	5.00	5.80	6.15	6.30	6.19	7.12	6.24
1730	5.12	6.24	5.93	5.10	5.65	6.10	6.94	5.94	5.78	5.69
1830	4.58	4.75	5.28	5.45	4.90	5.45	5.57	5.20	5.58	6.04
1930	4.48	5.45	5.23	4.85	5.40	4.90	5.13	4.50	5.28	6.29
2030	5.12	4.90	4.93	4.90	5.00	4.90	5.38	5.74	5.08	5.10
2130	5.17	4.60	4.83	4.95	4.95	5.15	4.99	6.09	4.88	5.64
2230	4.38	4.80	4.93	5.65	5.10	5.15	4.99	5.99	5.63	5.10
2330	4.72	4.80	5.58	5.05	5.65	4.75	5.33	4.70	4.58	5.69
24-Hr Mean	--	5.22	5.28	5.14	5.37	5.76	--	5.34	5.36	5.36
S.D.	--	0.55	0.38	0.49	0.41	0.59	--	0.54	0.62	0.60
S.E.	--	0.11	0.08	0.10	0.09	0.12	--	0.11	0.13	0.13
n	--	23	23	23	23	23	--	23	23	23

(continued)

Table 7 (continued). Oxygen consumption (liters/hour, STP) of monkey #337, Simple during 14.1-day pod trial.

Time	08 Jun 1975	09 Jun 1975	10 Jun 1975	11 Jun 1975	12 Jun 1975	Hourly Mean	S.D.	S.E.	n
0030	4.90	5.20	4.95	5.30	4.80	5.04	0.57	0.15	14
0130	4.70	4.50	4.90	4.95	5.84	5.10	0.45	0.13	13
0230	5.20	4.36	4.70	5.05	4.80	5.01	0.41	0.11	13
0330	4.85	5.10	4.50	5.15	4.95	4.88	0.39	0.11	13
0430	5.00	5.20	4.06	4.75	4.80	4.91	0.30	0.08	13
0530	4.70	5.15	4.11	4.11	4.31	4.65	0.41	0.11	13
0630	--	5.15	5.45	5.20	4.95	5.43	0.47	0.16	9
0730	4.46	5.00	--	4.70	5.30	5.11	0.50	0.16	10
0830	5.10	--	6.53	6.24	6.44	5.81	0.50	0.16	10
0930	6.73	5.30	6.34	--	5.35	5.78	0.60	0.18	11
1030	6.53	5.94	6.09	6.14	5.69	5.86	0.50	0.13	14
1130	4.85	5.69	5.15	5.59	5.40	5.34	0.42	0.11	14
1230	5.74	5.49	5.49	5.59	--	5.56	0.49	0.13	14
1330	6.19	5.89	6.44	5.79	--	5.70	0.62	0.17	14
1430	5.64	5.49	5.69	5.54	--	5.61	0.40	0.11	14
1530	5.89	5.64	5.89	5.69	--	5.69	0.48	0.13	14
1630	5.84	6.09	6.24	6.34	--	6.01	0.51	0.14	14
1730	6.39	6.39	6.09	5.89	--	5.95	0.49	0.13	14
1830	6.58	6.53	5.89	6.19	--	5.57	0.62	0.17	14
1930	5.45	5.00	5.40	5.54	--	5.21	0.46	0.12	14
2030	5.05	4.80	4.95	5.54	--	5.10	0.27	0.07	14
2130	4.95	4.26	5.15	5.20	--	5.06	0.43	0.12	14
2230	4.95	4.60	4.85	5.00	--	5.08	0.43	0.12	14
2330	4.90	4.65	4.70	4.50	--	4.97	0.42	0.11	14
24-Hr Mean	5.42	5.28	5.37	5.38	--				
S.D.	0.69	0.62	0.73	0.59	--				
S.E.	0.14	0.13	0.15	0.12	--				
n	23	23	23	23	--				

Table 8. Carbon dioxide production (liters/hour, STP) of monkey #337, Simple during 14.1-day pod trial.

Time	29 May 1975	30 May 1975	31 May 1975	01 Jun 1975	02 Jun 1975	03 Jun 1975	04 Jun 1975	05 Jun 1975	06 Jun 1975	07 Jun 1975
0030	--	3.79	4.55	3.78	4.20	6.25	5.05	4.35	3.81	4.58
0130	--	4.18	5.05	4.03	4.90	5.65	--	4.25	3.96	4.23
0230	--	4.87	4.55	3.78	4.40	5.25	--	4.40	4.75	3.78
0330	--	3.89	4.41	3.83	4.25	5.60	--	4.21	3.91	3.74
0430	--	4.48	4.75	3.88	4.40	4.65	--	4.01	4.21	4.43
0530	--	4.08	4.90	3.78	4.35	5.00	--	3.52	3.47	3.69
0630	--	5.22	--	--	5.15	5.90	--	4.50	3.76	--
0730	--	4.53	4.68	5.25	--	--	--	3.77	4.11	4.01
0830	--	--	4.93	4.80	5.30	5.75	--	--	4.60	4.36
0930	--	5.30	4.58	5.00	5.35	6.10	--	5.15	--	3.71
1030	--	4.80	5.33	4.05	4.70	5.90	5.53	4.90	5.23	5.49
1130	--	4.65	5.08	4.05	5.60	5.45	5.13	4.31	4.68	4.26
1230	4.53	5.54	4.38	4.55	5.50	5.65	5.97	5.45	4.18	5.49
1330	3.94	4.60	5.48	5.65	4.95	6.25	5.77	4.75	5.08	4.85
1430	4.62	5.15	4.98	4.65	5.60	5.45	5.77	4.36	4.98	5.10
1530	4.03	5.59	5.33	4.65	5.55	5.95	5.53	5.30	5.33	5.20
1630	4.53	5.35	5.38	4.50	5.65	5.60	5.97	5.25	6.23	5.84
1730	4.43	5.94	5.48	4.60	5.30	5.65	6.26	5.05	4.93	5.25
1830	3.79	4.41	4.68	5.10	4.60	5.10	4.94	4.26	4.73	5.69
1930	3.94	5.15	4.68	4.50	4.70	4.55	4.50	3.66	4.48	5.84
2030	4.43	4.55	4.28	4.65	4.75	4.45	4.69	4.95	4.38	4.46
2130	4.13	4.26	4.28	4.30	4.65	4.80	4.25	4.95	4.23	5.20
2230	3.99	4.60	4.18	5.35	4.75	4.75	4.21	4.95	4.98	4.70
2330	4.33	4.55	4.78	4.45	5.10	4.20	4.79	3.71	4.03	5.35
24-Hr Mean	--	4.76	4.81	4.48	4.94	5.39	--	4.52	4.52	4.75
S.D.	--	0.56	0.40	0.54	0.47	0.60	--	0.56	0.63	0.71
S.E.	--	0.12	0.08	0.11	0.10	0.13	--	0.12	0.13	0.15
n	--	23	23	23	23	23	--	23	23	23

(continued)

Table 8 (continued). Carbon dioxide production (liters/hour, STP) of monkey #337, Simple during 14.1-day pod trial.

Time	08 Jun 1975	09 Jun 1975	10 Jun 1975	11 Jun 1975	12 Jun 1975	Hourly Mean	S.D.	S.E.	n
0030	4.46	4.85	4.21	5.00	4.31	4.51	0.65	0.17	14
0130	4.31	4.11	4.21	4.26	5.45	4.51	0.56	0.16	13
0230	4.85	3.96	3.96	4.65	4.36	4.43	0.46	0.13	13
0330	4.50	4.75	3.76	4.75	4.36	4.30	0.52	0.14	13
0430	4.90	4.85	3.17	4.31	4.21	4.33	0.46	0.13	13
0530	4.36	4.70	3.32	3.61	3.66	4.03	0.57	0.16	13
0630	--	4.80	4.75	4.70	4.31	4.79	0.61	0.20	9
0730	3.91	4.36	--	4.16	4.70	4.34	0.45	0.14	10
0830	4.55	--	5.74	5.54	5.74	5.13	0.55	0.17	10
0930	5.89	4.60	5.64	--	4.80	5.10	0.68	0.21	11
1030	5.94	5.49	5.35	5.59	5.20	5.25	0.50	0.13	14
1130	3.96	5.20	4.60	5.00	4.85	4.77	0.51	0.14	14
1230	5.25	4.95	4.90	5.10	--	5.10	0.54	0.14	14
1330	5.69	5.30	5.99	5.20	--	5.25	0.61	0.16	14
1430	5.20	4.85	5.20	5.05	--	5.07	0.38	0.10	14
1530	5.45	5.05	5.64	5.35	--	5.28	0.47	0.13	14
1630	5.54	5.64	6.03	6.04	--	5.54	0.52	0.14	14
1730	5.84	5.94	5.54	5.35	--	5.39	0.52	0.14	14
1830	6.24	5.84	5.59	5.74	--	5.05	0.70	0.19	14
1930	4.80	4.21	5.00	5.15	--	4.65	0.54	0.14	14
2030	4.65	4.16	4.46	5.30	--	4.58	0.29	0.08	14
2130	4.50	3.56	4.80	4.75	--	4.48	0.42	0.11	14
2230	4.55	3.91	4.46	4.50	--	4.56	0.40	0.11	14
2330	4.60	4.16	4.36	4.31	--	4.48	0.43	0.12	14
24-Hr Mean	4.95	4.75	4.81	4.93	--				
S.D.	0.66	0.64	0.82	0.57	--				
S.E.	0.14	0.13	0.17	0.12	--				
n	23	23	23	23	--				

Table 9. Respiratory quotient of monkey #337, Simple during 14.1-day pod trial.

Time	29 May 1975	30 May 1975	31 May 1975	01 Jun 1975	02 Jun 1975	03 Jun 1975	04 Jun 1975	05 Jun 1975	06 Jun 1975	07 Jun 1975
0030	--	0.875	0.958	0.825	0.903	0.926	0.953	0.840	0.802	0.902
0130	--	0.858	0.953	0.826	0.907	0.926	--	0.843	0.808	0.867
0230	--	0.900	0.929	0.799	0.880	0.938	--	0.849	0.828	0.844
0330	--	0.878	0.938	0.810	0.876	0.949	--	0.827	0.806	0.854
0430	--	0.892	0.931	0.820	0.898	0.921	--	0.820	0.810	0.855
0530	--	0.901	0.933	0.808	0.861	0.952	--	0.791	0.796	0.824
0630	--	0.885	--	--	0.873	0.959	--	0.836	0.792	--
0730	--	0.868	0.886	0.833	--	--	--	0.795	0.806	0.802
0830	--	--	0.916	0.881	0.922	0.927	--	--	0.816	0.807
0930	--	0.885	0.859	0.885	0.915	0.953	--	0.853	--	0.798
1030	--	0.897	0.899	0.853	0.904	0.967	0.883	0.869	0.860	0.852
1130	--	0.886	0.902	0.890	0.941	0.948	0.913	0.898	0.846	0.852
1230	0.950	0.941	0.926	0.867	0.973	0.926	0.946	0.925	0.848	0.917
1330	0.931	0.902	0.965	0.942	0.925	0.933	0.937	0.880	0.894	0.924
1430	0.939	0.913	0.934	0.782	0.966	0.956	0.881	0.881	0.862	0.921
1530	0.931	0.941	0.938	0.921	0.965	0.960	0.920	0.908	0.877	0.922
1630	0.853	0.940	0.931	0.900	0.974	0.911	0.948	0.848	0.875	0.936
1730	0.865	0.952	0.924	0.902	0.938	0.926	0.902	0.850	0.853	0.923
1830	0.828	0.928	0.886	0.936	0.939	0.936	0.887	0.819	0.848	0.942
1930	0.879	0.945	0.895	0.928	0.870	0.929	0.877	0.813	0.848	0.928
2030	0.865	0.929	0.868	0.949	0.950	0.908	0.872	0.862	0.862	0.875
2130	0.799	0.926	0.886	0.869	0.939	0.932	0.852	0.813	0.867	0.922
2230	0.911	0.958	0.848	0.947	0.931	0.922	0.844	0.826	0.885	0.922
2330	0.917	0.948	0.857	0.881	0.903	0.884	0.899	0.789	0.880	0.940
24-Hr Mean	--	0.911	0.911	0.872	0.920	0.934	--	0.845	0.842	0.884
S.D.	--	0.030	0.034	0.052	0.034	0.019	--	0.037	0.032	0.048
S.E.	--	0.006	0.007	0.011	0.007	0.004	--	0.008	0.007	0.010
n	--	23	23	23	23	23	--	23	23	23

(continued)

Table 9 (continued). Respiratory quotient of monkey #337, Simple during 14.1-day pod trial.

Time	08 Jun 1975	09 Jun 1975	10 Jun 1975	11 Jun 1975	12 Jun 1975	Hourly Mean	S.D.	S.E.	n
0030	0.910	0.933	0.851	0.943	0.898	0.894	0.049	0.013	14
0130	0.917	0.913	0.859	0.861	0.933	0.882	0.045	0.012	13
0230	0.933	0.908	0.843	0.921	0.908	0.883	0.046	0.013	13
0330	0.928	0.931	0.836	0.922	0.881	0.880	0.051	0.014	13
0430	0.980	0.933	0.781	0.907	0.877	0.879	0.058	0.016	13
0530	0.928	0.913	0.808	0.878	0.849	0.872	0.061	0.017	13
0630	--	0.932	0.872	0.904	0.871	0.880	0.049	0.016	9
0730	0.877	0.872	--	0.885	0.887	0.851	0.038	0.012	10
0830	0.892	--	0.879	0.888	0.891	0.882	0.041	0.013	10
0930	0.875	0.868	0.890	--	0.897	0.880	0.039	0.012	11
1030	0.910	0.924	0.878	0.910	0.914	0.894	0.031	0.008	14
1130	0.816	0.914	0.893	0.894	0.898	0.892	0.035	0.009	14
1230	0.915	0.902	0.893	0.912	--	0.917	0.033	0.009	14
1330	0.919	0.900	0.930	0.898	--	0.920	0.023	0.006	14
1430	0.922	0.883	0.914	0.912	--	0.905	0.046	0.012	14
1530	0.925	0.895	0.958	0.940	--	0.929	0.025	0.007	14
1630	0.949	0.926	0.966	0.953	--	0.922	0.040	0.011	14
1730	0.914	0.926	0.910	0.908	--	0.907	0.031	0.008	14
1830	0.948	0.894	0.949	0.927	--	0.905	0.045	0.012	14
1930	0.881	0.842	0.926	0.930	--	0.892	0.040	0.011	14
2030	0.921	0.867	0.901	0.957	--	0.896	0.038	0.007	14
2130	0.909	0.836	0.932	0.913	--	0.885	0.047	0.012	14
2230	0.919	0.850	0.920	0.900	--	0.899	0.042	0.011	14
2330	0.939	0.895	0.928	0.958	--	0.901	0.044	0.012	14
24-Hr Mean	0.914	0.898	0.892	0.914	--				
S.D.	0.032	0.030	0.047	0.025	--				
S.E.	0.007	0.006	0.010	0.005	--				
n	23	23	23	23	--				

Table 10. Respiratory gas exchange (liters/hr, STP) of monkey #337, Simple during 14.1-day pod trial, 29 May - 12 June 1975.

	Oxygen Consumption	Carbon Dioxide Production	Respiratory Quotient
Over-all Mean \pm S.D. (n=315)	5.35 \pm 0.51	4.79 \pm 0.56	0.895 \pm 0.043
Light Cycle Mean \pm S.D. (n=152)	5.67 \pm 0.54	5.11 \pm 0.59	0.901 \pm 0.040
Dark Cycle Mean \pm S.D. (n=163)	5.06 \pm 0.48	4.50 \pm 0.54	0.889 \pm 0.046
P Light Cycle = Dark Cycle Value*	<0.001*	<0.001*	<0.02*

* Value of P <0.05 indicates a statistically significant difference between the two populations compared.

Table 11. Oxygen consumption (liters/hour, STP) of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	25 Jun 1975	26 Jun 1975	27 Jun 1975	28 Jun 1975	29 Jun 1975	30 Jun 1975	01 Jul 1975	02 Jul 1975	03 Jul 1975	04 Jul 1975
0030	--	3.71	3.07	4.01	4.06	4.88	4.60	4.20	4.15	4.42
0130	--	3.61	3.02	3.86	5.00	4.43	4.75	3.60	4.55	4.77
0230	--	3.56	3.27	3.71	4.21	4.03	4.30	3.80	4.00	4.92
0330	--	3.56	4.31	3.81	4.95	5.63	4.10	3.65	4.40	4.12
0430	--	3.47	3.51	3.86	3.96	4.28	3.95	3.50	3.90	3.97
0530	--	4.41	4.36	5.05	4.41	4.43	5.65	4.25	4.00	4.47
0630	--	6.44	5.20	5.54	--	6.18	5.60	5.50	5.35	5.37
0730	--	6.83	5.89	4.95	6.23	6.27	5.95	--	5.05	5.27
0830	--	--	6.09	5.69	5.83	--	6.75	5.85	--	5.27
0930	--	7.43	--	--	7.12	7.35	--	6.30	6.78	--
1030	--	5.89	6.48	--	6.27	6.30	--	5.75	5.57	--
1130	--	5.59	6.98	5.69	6.77	7.60	6.40	6.05	6.02	5.94
1230	5.74	5.35	5.84	5.64	6.23	5.90	6.90	6.0	6.53	6.44
1330	5.40	5.99	5.64	5.30	6.23	7.05	6.75	6.05	7.68	6.04
1430	6.24	5.35	5.64	5.59	6.32	5.80	6.80	6.25	7.73	6.29
1530	5.94	7.13	5.69	6.09	6.32	5.70	6.05	6.75	6.58	6.09
1630	6.24	6.39	5.40	5.69	6.67	5.85	6.30	5.90	5.77	5.73
1730	4.95	5.69	5.10	5.59	5.53	6.05	5.65	6.00	4.72	5.78
1830	4.41	4.11	3.91	4.80	4.73	5.35	4.55	5.25	4.97	5.43
1930	4.21	3.56	3.66	4.41	5.33	5.45	4.45	4.55	4.57	4.73
2030	3.96	3.32	3.47	4.50	4.48	4.80	4.25	4.45	4.37	4.73
2130	4.50	2.92	3.32	4.46	4.53	4.90	4.25	4.80	4.57	4.32
2230	3.61	3.27	4.46	4.11	4.63	4.50	4.10	4.25	4.12	6.64
2330	3.81	2.97	3.66	4.31	4.33	5.00	4.00	4.35	4.32	4.53
24-Hr Mean	--	4.81	4.69	4.85	5.40	5.55	5.28	5.09	5.20	5.24
S.D.	--	1.47	1.21	0.77	0.99	0.98	1.07	1.03	1.17	0.79
S.E.	--	0.30	0.25	0.16	0.21	0.20	0.23	0.21	0.24	0.17
n	--	23	23	22	23	23	22	23	23	22

(continued)

Table 11 (continued). Oxygen consumption (liters/hour, STP) of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	05 Jul 1975	06 Jul 1975	07 Jul 1975	08 Jul 1975	09 Jul 1975	10 Jul 1975	Hourly Mean	S.D.	S.E.	n
0030	4.73	4.63	4.58	4.88	4.17	3.72	4.25	0.50	0.13	15
0130	5.03	4.88	4.28	4.28	4.78	3.67	4.28	0.55	0.10	15
0230	4.78	4.12	4.07	4.17	4.07	4.07	4.07	0.42	0.11	15
0330	4.12	4.53	4.02	4.07	4.68	3.72	4.24	0.54	0.14	15
0430	4.28	3.97	4.53	4.28	3.92	3.62	3.93	0.32	0.08	15
0530	4.83	4.23	4.58	4.68	3.82	4.12	4.49	0.45	0.12	15
0630	6.04	--	5.23	5.78	5.33	5.13	5.59	0.41	0.11	13
0730	--	4.98	5.38	--	5.28	5.13	5.60	0.61	0.18	12
0830	5.83	4.88	6.49	6.29	--	5.08	5.82	0.58	0.7	11
0930	7.24	6.19	--	7.75	4.93	6.14	6.72	0.84	0.27	10
1030	8.40	6.29	--	7.14	4.63	--	6.27	1.00	0.32	10
1130	6.09	6.34	6.24	7.09	4.43	--	6.23	0.77	0.20	14
1230	6.39	5.48	7.09	6.84	4.88	--	6.09	0.62	0.16	15
1330	6.09	5.78	6.64	6.84	5.73	--	6.21	0.66	0.17	15
1430	6.19	5.53	6.44	6.69	5.03	--	6.13	0.67	0.17	15
1530	5.58	5.48	6.94	7.44	6.09	--	6.25	0.59	0.15	15
1630	6.64	5.13	6.94	6.59	6.04	--	6.09	0.51	0.13	15
1730	5.53	4.58	5.33	6.69	4.68	--	5.46	0.58	0.15	15
1830	5.28	4.68	5.38	5.78	4.73	--	4.89	0.52	0.14	15
1930	4.73	4.33	5.08	5.73	4.17	--	4.60	0.61	0.16	15
2030	4.53	4.73	4.68	4.83	3.97	--	4.33	0.47	0.12	15
2130	4.28	4.23	4.93	4.63	4.07	--	4.31	0.55	0.14	15
2230	4.83	4.07	4.17	4.43	4.58	--	4.38	0.74	0.19	15
2330	4.73	4.07	4.33	4.28	4.48	--	4.21	0.48	0.12	15
24-Hr Mean	5.48	4.92	5.33	5.70	4.72	--				
S.D.	1.05	0.74	1.04	1.23	0.64	--				
S.E.	0.22	0.15	0.22	0.26	0.13	--				
n	23	23	22	23	23	--				

Table 12. Carbon dioxide production (liters/hour, STP) of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	25 Jun 1975	26 Jun 1975	27 Jun 1975	28 Jun 1975	29 Jun 1975	30 Jun 1975	01 Jul 1975	02 Jul 1975	03 Jul 1975	04 Jul 1975
0030	--	2.92	2.43	3.66	3.61	4.33	3.95	3.50	3.75	3.97
0130	--	2.82	2.33	3.42	4.50	3.88	4.15	3.00	4.10	4.22
0230	--	2.77	2.52	3.32	3.71	3.44	3.70	3.15	3.65	4.37
0330	--	2.72	3.32	3.47	4.46	4.88	3.55	2.95	3.95	3.56
0430	--	2.72	2.82	3.51	3.51	3.64	3.45	2.90	3.50	3.51
0530	--	3.37	3.56	4.55	4.11	3.93	4.90	3.55	3.55	4.12
0630	--	4.85	4.11	4.75	--	5.48	4.90	4.55	4.65	4.82
0730	--	5.10	4.80	4.31	5.33	5.53	5.15	--	4.25	4.52
0830	--	--	4.85	5.05	5.03	--	5.85	4.70	--	4.47
0930	--	5.89	--	--	6.23	6.35	--	5.15	5.97	--
1030	--	4.26	5.35	--	5.68	5.70	--	5.05	4.92	--
1130	--	4.36	5.94	4.55	6.08	6.55	5.55	5.30	5.57	5.38
1230	4.36	4.11	4.90	4.70	5.53	5.15	6.35	5.55	6.12	6.14
1330	4.01	4.90	4.70	4.46	5.93	6.35	6.00	5.45	7.02	5.58
1430	4.80	4.21	4.75	5.05	5.73	4.95	6.20	5.55	6.93	5.94
1530	4.31	6.39	4.90	5.64	5.73	5.20	5.50	6.15	6.02	5.73
1630	4.75	4.75	4.55	5.15	6.08	5.25	5.55	5.20	5.22	5.38
1730	3.66	4.16	4.31	4.90	4.93	5.40	4.95	5.40	4.22	5.43
1830	3.22	2.97	3.32	4.26	4.48	4.75	3.95	4.65	4.62	5.03
1930	3.17	2.72	3.27	3.96	4.78	4.80	3.85	4.05	4.17	4.43
2030	2.92	2.52	3.12	4.11	4.03	4.20	3.75	4.00	4.07	4.53
2130	3.27	2.28	3.07	3.81	4.13	4.30	3.55	4.25	4.17	4.02
2230	2.77	2.52	4.01	3.86	4.13	3.90	3.50	3.75	3.82	6.34
2330	2.92	2.28	3.32	3.91	3.88	4.35	3.45	3.95	3.77	4.33
24-Hr Mean	--	3.72	3.92	4.29	4.85	4.88	4.63	4.42	4.70	4.81
S.D.	--	1.20	1.01	0.64	0.89	0.88	1.01	0.97	1.08	0.82
S.E.	--	0.25	0.21	0.14	0.18	0.18	0.22	0.20	0.22	0.18
n	--	23	23	22	23	23	22	23	23	22

(continued)

Table 12 (continued). Carbon dioxide production (liters/hour, STP) of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	05 Jul 1975	06 Jul 1975	07 Jul 1975	08 Jul 1975	09 Jul 1975	10 Jul 1975	Hourly Mean	S.D.	S.E.	n
0030	4.58	4.28	4.43	4.48	3.27	3.37	3.77	0.61	0.16	15
0130	4.83	4.53	4.07	4.02	3.77	3.37	3.80	0.69	0.18	15
0230	4.53	3.82	3.87	3.97	3.12	3.67	3.57	0.54	0.14	15
0330	3.97	4.28	3.82	3.87	3.47	3.37	3.71	0.56	0.14	15
0430	4.02	3.62	4.33	3.97	2.97	3.37	3.46	0.46	0.12	15
0530	4.58	3.82	4.28	4.43	2.87	3.82	3.71	0.55	0.10	15
0630	5.63	--	4.78	5.33	4.33	4.68	4.84	0.43	0.12	13
0730	--	4.53	5.03	--	4.07	4.68	4.78	0.46	0.13	12
0830	5.08	4.43	5.94	5.68	--	4.58	5.06	0.54	0.16	11
0930	6.34	5.58	--	6.94	3.97	5.53	5.80	0.82	0.26	10
1030	6.64	5.78	--	6.34	3.52	--	5.32	0.93	0.30	10
1130	5.58	5.83	5.89	6.14	3.37	--	5.44	0.83	0.22	14
1230	5.94	5.13	6.79	6.04	3.77	--	5.37	0.88	0.23	15
1330	5.68	5.38	6.04	6.04	4.73	--	5.48	0.80	0.21	15
1430	5.73	5.18	6.19	5.99	4.33	--	5.44	0.76	0.20	15
1530	5.18	5.13	6.39	6.64	5.43	--	5.62	0.63	0.16	15
1630	6.19	4.83	6.14	5.94	5.13	--	5.34	0.54	0.14	15
1730	4.83	4.38	4.78	5.58	4.02	--	4.73	0.58	0.15	15
1830	4.83	4.43	4.93	4.78	4.23	--	4.30	0.65	0.17	15
1930	4.38	4.12	4.78	4.68	3.67	--	4.06	0.63	0.16	15
2030	4.17	4.48	4.28	3.92	3.57	--	3.84	0.58	0.15	15
2130	4.02	4.02	4.58	3.77	3.62	--	3.79	0.58	0.15	15
2230	4.53	3.92	3.82	3.52	4.17	--	3.90	0.85	0.22	15
2330	4.43	3.87	4.07	3.37	3.67	--	3.70	0.57	0.15	15
24-Hr Mean	5.03	4.58	4.97	5.02	3.87	--				
S.D.	0.79	0.66	0.94	1.11	0.64	--				
S.E.	0.17	0.14	0.20	0.23	0.13	--				
n	23	23	22	23	23	--				

Table 13. Respiratory quotient of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	25 Jun 1975	26 Jun 1975	27 Jun 1975	28 Jun 1975	29 Jun 1975	30 Jun 1975	01 Jul 1975	02 Jul 1975	03 Jul 1975	04 Jul 1975
0030	--	0.787	0.792	0.913	0.889	0.887	0.859	0.833	0.904	0.898
0130	--	0.781	0.772	0.886	0.900	0.876	0.874	0.833	0.901	0.885
0230	--	0.778	0.771	0.895	0.881	0.854	0.860	0.829	0.913	0.888
0330	--	0.764	0.770	0.911	0.901	0.867	0.866	0.808	0.898	0.864
0430	--	0.784	0.803	0.909	0.886	0.850	0.873	0.829	0.897	0.884
0530	--	0.764	0.817	0.901	0.932	0.887	0.867	0.835	0.888	0.922
0630	--	0.753	0.790	0.857	--	0.887	0.875	0.827	0.869	0.898
0730	--	0.747	0.815	0.871	0.856	0.882	0.866	--	0.842	0.858
0830	--	--	0.796	0.888	0.863	--	0.867	0.803	--	0.848
0930	--	0.793	--	--	0.875	0.864	--	0.817	0.881	--
1030	--	0.723	0.826	--	0.906	0.905	--	0.878	0.883	--
1130	--	0.780	0.851	0.800	0.898	0.862	0.867	0.876	0.925	0.906
1230	0.760	0.768	0.839	0.833	0.888	0.873	0.920	0.910	0.937	0.953
1330	0.743	0.818	0.833	0.842	0.952	0.901	0.889	0.901	0.914	0.924
1430	0.769	0.787	0.842	0.903	0.907	0.853	0.912	0.888	0.897	0.944
1530	0.726	0.896	0.861	0.926	0.907	0.912	0.909	0.911	0.915	0.941
1630	0.761	0.743	0.843	0.905	0.912	0.897	0.881	0.881	0.905	0.939
1730	0.739	0.731	0.845	0.877	0.892	0.893	0.876	0.900	0.894	0.939
1830	0.730	0.723	0.849	0.888	0.947	0.888	0.868	0.886	0.930	0.926
1930	0.753	0.764	0.893	0.898	0.897	0.881	0.865	0.890	0.912	0.937
2030	0.737	0.759	0.899	0.913	0.900	0.875	0.882	0.899	0.931	0.958
2130	0.727	0.781	0.925	0.854	0.912	0.878	0.835	0.885	0.912	0.931
2230	0.767	0.771	0.899	0.939	0.892	0.867	0.854	0.882	0.927	0.955
2330	0.766	0.768	0.907	0.907	0.896	0.870	0.863	0.908	0.873	0.956
24-Hr Mean	--	0.772	0.836	0.887	0.900	0.879	0.874	0.866	0.902	0.916
S.D.	--	0.035	0.046	0.033	0.023	0.017	0.019	0.036	0.022	0.034
S.E.	--	0.007	0.010	0.007	0.005	0.003	0.004	0.008	0.005	0.007
n	--	23	23	22	23	23	22	23	23	22

(continued)

Table 13 (continued). Respiratory quotient of monkey #341, Philostrate during 15-day (5x3 days) pod trial.

Time	05 Jul 1975	06 Jul 1975	07 Jul 1975	08 Jul 1975	09 Jul 1975	10 Jul 1975	Hourly Mean	S.D.	S.E.	n
0030	0.968	0.924	0.967	0.918	0.784	0.906	0.882	0.060	0.015	15
0130	0.960	0.928	0.951	0.939	0.789	0.918	0.880	0.061	0.016	15
0230	0.946	0.927	0.951	0.952	0.767	0.902	0.874	0.064	0.016	15
0330	0.964	0.945	0.950	0.951	0.741	0.906	0.874	0.073	0.019	15
0430	0.939	0.912	0.950	0.928	0.758	0.931	0.876	0.060	0.015	15
0530	0.948	0.903	0.934	0.947	0.751	0.927	0.881	0.063	0.016	15
0630	0.932	--	0.914	0.922	0.812	0.912	0.865	0.055	0.015	13
0730	--	0.910	0.935	--	0.771	0.912	0.855	0.056	0.016	12
0830	0.871	0.908	0.915	0.903	--	0.902	0.869	0.041	0.012	11
0930	0.876	0.901	--	0.895	0.805	0.900	0.861	0.041	0.013	10
1030	0.790	0.919	--	0.888	0.760	--	0.848	0.069	0.022	10
1130	0.916	0.920	0.944	0.866	0.761	--	0.869	0.056	0.015	14
1230	0.930	0.936	0.958	0.883	0.773	--	0.877	0.068	0.018	15
1330	0.933	0.931	0.910	0.883	0.825	--	0.880	0.057	0.015	15
1430	0.926	0.937	0.961	0.895	0.861	--	0.885	0.055	0.014	15
1530	0.928	0.936	0.921	0.892	0.892	--	0.898	0.052	0.012	15
1630	0.932	0.942	0.885	0.901	0.849	--	0.878	0.059	0.015	15
1730	0.873	0.956	0.897	0.834	0.859	--	0.867	0.062	0.016	15
1830	0.915	0.947	0.916	0.827	0.894	--	0.876	0.069	0.018	15
1930	0.926	0.952	0.941	0.817	0.880	--	0.880	0.060	0.015	15
2030	0.921	0.947	0.915	0.812	0.899	--	0.883	0.064	0.017	15
2130	0.939	0.950	0.929	0.814	0.889	--	0.877	0.064	0.017	15
2230	0.938	0.963	0.916	0.795	0.910	--	0.885	0.064	0.016	15
2330	0.937	0.951	0.940	0.787	0.819	--	0.877	0.065	0.017	15
24-Hr Mean	0.922	0.932	0.932	0.880	0.820	--				
S.D.	0.039	0.018	0.022	0.052	0.056	--				
S.E.	0.008	0.004	0.005	0.011	0.012	--				
n	23	23	22	23	23	--				

Table 14. Respiratory gas exchange (liters/hr, STP) of monkey #341, Philostrate during 15-day (5 x 3 days) pod trial, 25 June - 10 July 1975.

	Oxygen Consumption	Carbon Dioxide Production	Respiratory Quotient
Over-all Mean \pm S.D. (n=340)	5.14 \pm 0.63	4.50 \pm 0.69	0.876 \pm 0.059
1st 3-Day Mean \pm S.D. (n=67)	4.75 \pm 1.21	3.82 \pm 0.99	0.806 \pm 0.059
2nd 3-Day Mean \pm S.D. (n=68)	5.35 \pm 0.93	4.73 \pm 0.83	0.885 \pm 0.026
3rd 3-Day Mean \pm S.D. (n=68)	5.15 \pm 1.05	4.55 \pm 0.99	0.883 \pm 0.031
4th 3-Day Mean \pm S.D. (n=68)	5.22 \pm 0.91	4.85 \pm 0.76	0.931 \pm 0.027
5th 3-Day Mean \pm S.D. (n=69)	5.19 \pm 1.10	4.55 \pm 1.07	0.873 \pm 0.061
Light Cycle Mean \pm S.D. (n=160)	6.03 \pm 0.71	5.27 \pm 0.75	0.873 \pm 0.056
Dark Cycle Mean \pm S.D. (n=180)	4.34 \pm 0.56	3.82 \pm 0.63	0.879 \pm 0.062
P Light Cycle = Dark Cycle Value*	<0.001*	<0.001*	<0.10

* Value of P <0.05 indicates a statistically significant difference between the two populations compared.

Table 15. Oxygen consumption (liters/hour, STP) of two monkeys during two-pod trial, 29 July - 1 August 1975.

Time	#341, Philostrate				#174, Exeter			
	29 Jul	30 Jul	31 Jul	01 Aug	29 Jul	30 Jul	31 Jul	01 Aug
0030	--	3.10	3.69	3.46	--	4.43	3.84	4.39
0130	--	3.72	3.33	3.21	--	3.97	3.94	4.81
0230	--	3.41	3.38	3.21	--	4.12	3.84	3.98
0330	--	3.92	3.69	3.00	--	4.63	3.89	4.39
0430	--	5.96	5.17	3.46	--	3.97	3.74	3.83
0530	--	5.04	5.27	5.17	--	4.02	4.40	5.07
0630	--	6.87	5.17	4.86	--	4.63	5.17	5.74
0730	--	7.28	6.14	6.36	--	4.63	4.30	6.10
0830	--	7.08	5.79	--	--	5.75	4.51	--
0930	--	--	--	--	--	--	--	--
1030	--	7.94	7.29	--	--	5.17	4.70	--
1130	--	6.60	7.39	--	--	4.45	3.93	--
1230	--	7.07	8.01	--	--	5.27	6.41	--
1330	--	5.84	6.98	--	--	4.25	5.27	--
1430	--	6.76	6.67	--	--	4.04	4.81	--
1530	--	6.45	5.79	--	--	6.35	5.22	--
1630	6.21	6.50	6.72	--	5.55	5.58	4.86	--
1730	5.90	5.84	5.12	--	4.22	3.94	4.08	--
1830	4.58	4.97	4.45	--	4.12	3.79	3.83	--
1930	4.38	3.89	3.72	--	4.07	3.99	4.60	--
2030	3.87	3.69	3.83	--	3.92	4.66	3.83	--
2130	3.66	3.69	3.57	--	4.63	3.89	4.03	--
2230	3.61	3.33	3.41	--	4.28	4.15	4.34	--
2330	3.51	3.38	3.15	--	4.33	3.89	4.19	--

Table 16. Carbon dioxide production (liters/hour, STP) of two monkeys during two-pod trial, 29 July - 1 August 1975.

Time	#341, Philostrate				#174, Exeter			
	29 Jul	30 Jul	31 Jul	01 Aug	29 Jul	30 Jul	31 Jul	01 Aug
0030	--	2.75	3.17	3.00	--	3.82	3.48	4.14
0130	--	3.36	2.87	2.95	--	3.51	3.33	4.50
0230	--	2.95	2.92	2.79	--	3.72	3.17	3.72
0330	--	3.36	3.23	2.64	--	4.12	3.28	4.08
0430	--	5.19	4.76	3.00	--	3.66	3.23	3.57
0530	--	4.28	4.56	4.50	--	3.66	3.89	4.81
0630	--	5.80	4.30	4.14	--	4.22	4.35	5.27
0730	--	6.31	5.12	5.48	--	4.17	3.48	5.38
0830	--	6.11	4.61	--	--	5.09	3.74	--
0930	--	--	--	--	--	--	--	--
1030	--	7.07	6.31	--	--	4.40	3.98	--
1130	--	5.84	7.03	--	--	3.99	3.52	--
1230	--	6.30	7.50	--	--	4.56	5.89	--
1330	--	5.07	6.36	--	--	3.53	4.55	--
1430	--	5.89	6.05	--	--	3.48	4.39	--
1530	--	5.53	5.17	--	--	5.53	4.70	--
1630	5.29	5.84	6.20	--	4.99	4.86	4.39	--
1730	5.29	5.43	4.55	--	3.66	3.38	3.52	--
1830	3.66	4.51	3.98	--	3.66	3.43	3.52	--
1930	3.66	3.53	3.36	--	3.66	3.53	4.39	--
2030	3.36	3.43	3.57	--	3.56	4.20	3.52	--
2130	3.05	3.33	3.15	--	4.28	3.53	3.88	--
2230	3.10	2.97	3.15	--	3.82	3.84	4.24	--
2330	2.95	2.97	2.84	--	3.87	3.48	3.98	--

Table 17. Respiratory quotient of two monkeys during a two-pod trial.

Time	#341, Philostrate				#174, Exeter			
	29 Jul	30 Jul	31 Jul	01 Aug	29 Jul	30 Jul	31 Jul	01 Aug
0030	--	0.887	0.859	0.867	--	0.862	0.906	0.943
0130	--	0.903	0.862	0.919	--	0.884	0.845	0.936
0230	--	0.865	0.864	0.869	--	0.903	0.826	0.935
0330	--	0.857	0.875	0.880	--	0.890	0.843	0.929
0430	--	0.871	0.921	0.867	--	0.922	0.864	0.932
0530	--	0.849	0.865	0.870	--	0.910	0.884	0.949
0630	--	0.844	0.832	0.852	--	0.911	0.841	0.918
0730	--	0.867	0.834	0.862	--	0.901	0.809	0.882
0830	--	0.863	0.796	--	--	0.885	0.829	--
0930	--	--	--	--	--	--	--	--
1030	--	0.890	0.866	--	--	0.851	0.847	--
1130	--	0.885	0.951	--	--	0.897	0.896	--
1230	--	0.891	0.936	--	--	0.865	0.919	--
1330	--	0.868	0.911	--	--	0.831	0.863	--
1430	--	0.871	0.907	--	--	0.861	0.913	--
1530	--	0.857	0.893	--	--	0.871	0.900	--
1630	0.852	0.898	0.923	--	0.899	0.871	0.903	--
1730	0.897	0.930	0.889	--	0.867	0.858	0.863	--
1830	0.799	0.907	0.894	--	0.888	0.905	0.919	--
1930	0.836	0.907	0.903	--	0.899	0.885	0.954	--
2030	0.868	0.930	0.932	--	0.908	0.901	0.919	--
2130	0.833	0.902	0.882	--	0.924	0.907	0.963	--
2230	0.859	0.892	0.924	--	0.893	0.925	0.977	--
2330	0.840	0.879	0.902	--	0.894	0.895	0.950	--

Table 18. Respiratory gas exchange (liters/hr, STP) of two monkeys during two-pod trial, 29 July - 1 August 1975.

Monkey #174, Exeter		Oxygen Consumption	Carbon Dioxide Production	Respiratory Quotient
Over-all Mean	\pm S.D. (n=62)	4.50 \pm 0.50	4.02 \pm 0.52	0.894 \pm 0.032
Light Cycle Mean	\pm S.D. (n=26)	4.96 \pm 0.74	4.35 \pm 0.72	0.875 \pm 0.030
Dark Cycle Mean	\pm S.D. (n=36)	4.16 \pm 0.33	3.78 \pm 0.38	0.907 \pm 0.034
P	Light Cycle = Dark Cycle Value*	<0.001*	<0.001*	<0.001*
Monkey #341, Philostrate		Oxygen Consumption	Carbon Dioxide Production	Respiratory Quotient
Over-all Mean	\pm S.D. (n=62)	4.98 \pm 0.76	4.38 \pm 0.72	0.879 \pm 0.032
Light Cycle Mean	\pm S.D. (n=26)	6.49 \pm 0.81	5.72 \pm 0.84	0.879 \pm 0.035
Dark Cycle Mean	\pm S.D. (n=36)	3.89 \pm 0.73	3.41 \pm 0.63	0.879 \pm 0.029
P	Light Cycle = Dark Cycle Value*	<0.001*	<0.001*	>0.10

* Value of P <0.05 indicates a statistically significant difference between the two populations compared.

Table 19. Respiratory gas exchange as a function of body weight and body cell mass in two monkeys during two-pod trial, 29 July - 1 August 1975.

Monkey	#174, Exeter	#341, Philostrate
Body weight (kg)	13.09	10.75
Body potassium content (meq)	704	754
Body cell mass (kg)	5.86	6.28
Oxygen consumption (STP)		
Liters/hour	4.50	4.98
Liters/hour/kg BW	0.34	0.46
Liters/hour/kg BCM	0.77	0.79
Carbon dioxide production (STP)		
Liters/hour	4.02	4.38
Liters/hour/kg BW	0.31	0.41
Liters/hour/kg BCM	0.69	0.70

Table 20. Thyroid related hormone levels in the blood serum of 6 male adult pig-tailed monkeys.

Monkey No. Name	Total T4 $\mu\text{g}/100\text{ ml}$	Total T3 $\text{ng}/100\text{ ml}$	Free T4 $\mu\text{g}/100\text{ ml}$	Free T3 $\text{ng}/100\text{ ml}$	TSH $\mu\text{unit}/1\text{ ml}$
175, Salisbury	5.03	81.6	2.24	40.2	7.40
200, Hume	5.92	173.0	3.75	81.5	1.98
290, Lymoges	5.04	100.2	2.54	62.0	2.66
307, Angelo	4.77	125.0	--	79.6	3.44
377, Ross	5.50	96.6	3.96	62.4	1.90
411, Gregory	5.17	99.5	2.95	55.0	2.42

Table 21. Metabolic balance on a monkey in pod for 4.96 days,
#337, Simple. (Test conducted at MSFC as CVT/GPL III,
14-19 July 1974)

Total number of pellets consumed	1267
Pellets analyzed (grams)	100.98
Petroleum ether extract in pellets (per cent)	2.5
Freeze-dried paper plus excreta (grams)	623.0
Weight of paper (grams)	451.89
Net weight of excreta (grams)	171.11
Weight of petroleum ether extract (grams)	2.32
Per cent of petroleum ether extract	1.36
Weight of freeze-dried and defatted excreta (grams)	168.79
Ratio of excreta to total freeze dried weight:	$\frac{168.79}{620.68}$ 0.272
"Dilution factor" due to paper:	$\frac{620.68}{168.79}$ 3.68

	<u>Intake</u> (g)	<u>Output</u> (g)	<u>Output</u> <u>Input</u> x100	<u>Method</u> K-Kjeldahl A-Ashing
Nitrogen	37.16	5.43	14.6	K
Phosphorus	(5.88	5.48	93.2	K
	(5.86	5.48	93.5	A
Chlorine	4.65	2.91	62.6	A
Calcium	10.84	10.93	100.8	A
Magnesium	(1.58	1.49	94.3	K
	(1.53	1.48	96.7	A
Sodium	2.46	1.82	74.0	K
Potassium	7.85	6.80	86.6	K
Iron	0.43	0.38	88.4	A

Table 22. Metabolic balance on a monkey in pod for 14.1 days,
#337, Simple. 29 May to 12 June 1975.

Total number of pellets consumed	3,080
Total dry and defatted weight of pellets (grams)	2,365.44 ¹
Total dry and defatted weight of urine and feces (grams)	400.40 ²
Hair -- about 50%-70% of total (grams)	3.0 ³
Total petroleum ether extract of excreta (grams)	13.0

Note: "dry" refers to freeze-dried material, defatted, and again dried to constant weight at 100°C.

	Intake ⁴ (g)	Output ⁵ (g)	$\frac{\text{Output}}{\text{Input}} \times 100$	Method K-Kjeldahl A-Ashing
Nitrogen	93.37	16.53	17.7	K
Phosphorus	(14.88 14.00)	13.33 13.23	89.6 94.5	K A
Chlorine	10.65	7.42	69.7	A
Calcium	26.48	22.26	84.1	A
Magnesium	(3.93 4.08)	3.13 3.25	79.6 79.7	K A
Sodium	5.84	4.40	75.3	K
Potassium	19.85	18.65	94.0	K
Iron	1.046	0.862	82.4	A

¹ Weight calculated from the analysis of 314 pellets (about 10% of total consumed) taken from the same stock as fed the animal. The dry, defatted, 314 pellets weighed 241.07 g, or 0.768 g per pellet. The petroleum ether extract was 2.8%.

² After oven drying, this amount was ground 3 times in a Wiley mill.

³ Only big clumps of hair were collected and subsequently washed with soap, followed with alcohol and petroleum ether.

⁴ Calculated on the basis of the consumption of 2365.44 g.

⁵ Calculated on the basis of 400.40 g total output.

Table 23. Analysis of standard reference bovine liver and orchard leaves from National Bureau of Standards (NBS)

	Bovine Liver (NBS-1577) ¹				Orchard Leaves (NBS-1571) ²				Standard Chemical Mixture		
	NBS		EPL	Optimum Sample g	NBS		EPL	Optimum Sample g			Method
	mg/g	± mg	mg/g		mg/g	± mg	mg/g		g		
Nitrogen	106.0	6.0	101.9	0.5	27.6	0.5	27.8	0.5	K	28.0	94
Phosphorus	NOT GIVEN		12.6	0.5-2	2.1	0.1	2.1	2	K	12.4	99
			12.5	0.5	2.1		2.2	0.5-2	A		
Chlorine	(2.600)		2.835	2+	(0.700)		0.735	2+	A	9.52	104
Potassium	9.7	0.6	9.4	2	14.7	0.3	13.3	2	K	14.0	90
Sodium	2.43	0.13	2.34	2	0.082	0.006	QNS	2+	A	2.3	106
Calcium	(0.123)		0.162	2	20.9	0.3	22.2	0.5-2	A	4.02	100
Magnesium	(0.605)		0.660	0.5-2	6.2	0.2	5.94	1	K	0.486	99
	(0.605)		0.608	2	6.2		6.14	0.5-1.5	A	0.486	104
Iron	0.270	0.020	0.276	1-2	0.300	0.020	0.289	2	A	NOT RUN	

¹ Sample contained 11.4% water.

² Sample contained 10% water.

EPL - This laboratory.

() - Values in parenthesis not certified by NBS.

+ - Sample size should be larger.

QNS - Not sufficient sodium in sample for the dilutions used. Sample should be 10-20 fold larger.

K - Kjeldahl.

A - Alkaline ashing.

Table 24. Census of pig-tailed monkeys for the period
1 Feb 1975 - 31 July 1975.

	Feb	Mar	Apr	May	Jun	Jul
No. at start of month	30	32	32	32	32	32
Acquisitions	2	0	0	0	0	0
Losses	0	0	0	0	0	1*
No. at end of month	32	32	32	32	32	31

* #337, Simple transferred to NASA/ARC on 17 July 1975 for
proposed T/M implant surgery.